The implementation of intersectoral community approaches targeting childhood obesity

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THE IMPLEMENTATION OF INTERSECTORAL COMMUNITY APPROACHES TARGETING CHILDHOOD OBESITY

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General introduction

1

General introduction

Childhood obesity

Since the early seventies, the worldwide prevalence of childhood obesity has increased alarmingly (1,2). A child between the ages of 2-19 is said to be overweight if his Body Mass Index (BMI) is at or above the 85th percentile of the growth chart for children of the same age and gender, and from obesity if his BMI is at or above the 95th percentile (3). An estimated 14% of children in the Netherlands can be classified as overweight, whereas in the United States of America one in three children is overweight (4). Children who are overweight have an increased chance of developing physical problems such as diabetes type 2, high blood pressure, increased cholesterol levels and musculoskeletal disorders (5,6). Moreover, being an overweight child increases the likelihood of developing psychosocial problems such as a low self-esteem, feelings of depression, lower academic achievements and stigmatization by peers. If a child is overweight, the risk of becoming an overweight adult is high (7). Approximately 75% of obese adolescents will remain obese as an adult (8,9). Obesity in adulthood can have severe consequences such as cardiovascular diseases, metabolic syndrome, cancer and early mortality (10,11). The rising obesity trend has led to growing concerns about attributed health care costs; in the United States alone obesity accounts for an extra 315.8 billion US dollar in annual medical costs (12). The aetiology of child obesity is complex, involving dynamic interactions between nutritional intake, physical activity, genetic factors but also social and environmental factors (1, 13-18). For instance, the combination of living in an obesogenic environment or community and being exposed to a parenting style encouraging a sedentary lifestyle and high calorie diet could lead to childhood obesity in a specific child, whereas the obesogenic environment alone would not (17).

An adequate intervention to tackle childhood obesity

As a result of the alarming childhood obesity prevalence and related burden of disease and costs, the quest to develop an adequate intervention to prevent and reduce childhood obesity has intensified in the last decade (19-22). It is argued that to successfully prevent childhood obesity over time, an intervention should be built upon existing community resources and take into account the multifactorial aetiology of childhood obesity (23). Based on this rationale, several Intersectoral Community Approaches to target Childhood Obesity (IACOs) were developed worldwide (24). An IACO aims to address a diverse pallet of childhood obesity determinants via (intersectoral) activities performed by community partners operating at different levels (such as policy officials, project managers, health professionals, teachers). The goal is to create a nonobesogenic environment in which a child is less likely to become obese (25,26). One of the most successful IACOs to date is The

French 'Ensemble Prevenons l'Obesité Des Enfants' (EPODE) program (27-29). EPODE started as a nutritional intervention program at schools in two small towns, Fleurbaix and Laventie. After the approach was found to be successful in the schools, community stakeholders and the local mayor became enthusiastic about the program. The program was then further developed into a community-based approach, targeting both physical activity and nutrition in multiple sectors (figure 1). The resulting EPODE community program is based on four central pillars; namely the presence of political and organizational commitment, collaboration between public and private organizations, use of social marketing, and support of scientific evaluation. Favourable results in the EPODE pilot towns (30) led to the development of several EPODE-derived IACOs in over 40 countries (27,28), and the establishment of an international network for the management of EPODE-derived IACOs (31). In the Netherlands, the EPODE-derived JOGG approach (an acronym for Youth On a Healthy Weight, in Dutch) was developed. JOGG follows the four EPODE pillars, but also adds a fifth pillar to meet the needs of the Dutch health care system; the reinforcement of linkages between preventive and curative health care (32).

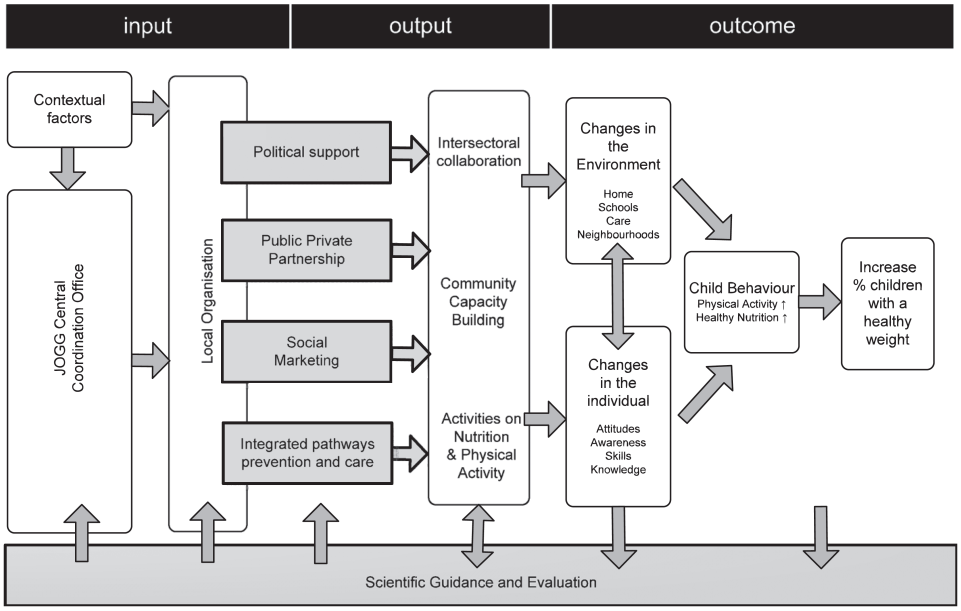

Figure 1. EPODE-derived JOGG program methodology

The translation of an IACO into practice

However, results of IACOs on behavioural and health outcomes in children vary greatly, and the intended outcomes have mostly been small and short term (33,34). One possible explanation for this lack of effectiveness is the translational gap often reported between the IACO as described by its developers and the IACO as executed in practice. Translation of a program into practice is a complex process, which was extensively described by Rogers (35) when he introduced his theory on the 'diffusion of innovations'. Rogers demarcated four essential stages; the process of innovation starts with the phase of dissemination (spreading knowledge and awareness about the innovation), followed by adoption (the formation of attitudes and intentions towards using the innovation), implementation (putting the innovation into practice) and continuation (continuing with using the innovation).

If somewhere along this process the translation of the program into practice fails, this can lead to a decreased exposure of the target population to (critical parts of) the program (36-38). This, in turn, can cause a decline in or even absence of intervention effect. If only intervention effect and not the diffusion process itself is evaluated, a failure in translation can even lead to the unjust conclusion that the intervention in itself is ineffective (type III error) (39).

Evaluating the process of translation

To prevent such errors and gain knowledge on the diffusion process, an evaluation of the process (further referred to as 'process evaluation') is necessary (36,37). IACOs are dynamic and their program plans are adjusted and amended in time following community developments. Hence, an IACO process evaluation should also by dynamic; the evaluation needs to be revised iteratively according to the cumulating changes in program planning (38,40). Saunders *et al.* (37) provide a framework to guide such a dynamic process evaluation, specifically for the phases of initial implementation and continued implementation (further referred to as 'implementation process'). An adapted version of this framework was used to guide this study and is displayed in figure 2. An IACO process evaluation can shed light on (a) if and to which extent an IACO is implemented as intended, but also on (b) which determinants impede or facilitate the implementation process (40,41). Considering the first, a variety of aspects have been proposed to indicate if a program is implemented as intended. No consensus, however, is reached in the literature on the operationalization or measurement of these aspects (42,43). In the widely cited 'Glossary for Dissemination and Implementation Research in Health', Rabin *et al.* (44) state that there are four main aspects that indicate the extent to which a program is translated as intended. These four aspects

are (a) adherence to the program plan, (b) dose or the amount of the program delivered, (c) quality of program delivery and (d) reaction and acceptance by the target population. Together, these aspects are referred to as implementation fidelity.

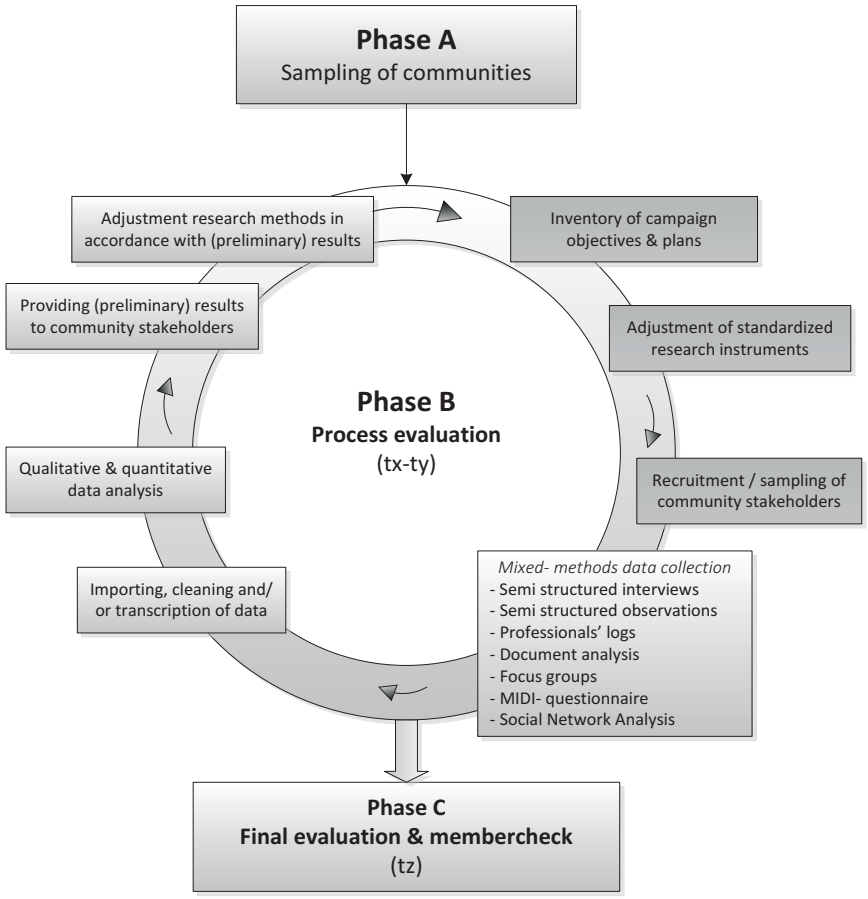

Figure 2. Adapted framework of Saunders *et al.*[37]

As for determinants, several models have been proposed to describe and categorize the determinants of the implementation of innovations (41,43,45-48). Fleuren *et al*. (49) constructed a model (figure 3) clustering determinants of the implementation of health care interventions mainly based on the Theory of Planned Behaviour (50), Social Cognitive Theory (51) and on data derived from a series of qualitative and quantitative implementation

studies. This model categorizes 50 determinants into (a) characteristics of the socio-political context, (b) characteristics of the organization, (c) characteristics of the intended user and (d) characteristics of the innovation. A recent review evaluating determinants of the innovation process underlines the use of this type of categorization (45). Based on this model, a Measurement Instrument for Determinants of Innovation (MIDI) was developed in 2014 to quantitatively assess determinants of the innovation process (52).

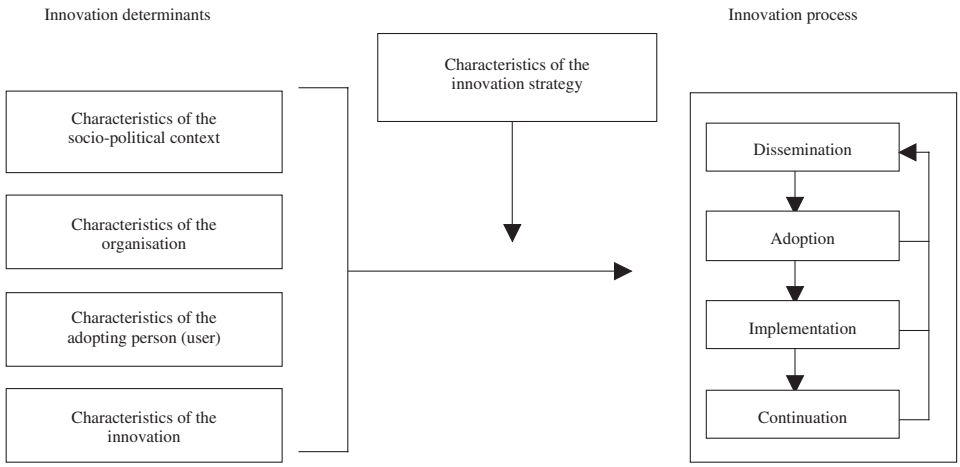

Figure 3. Fleuren framework

Research on the implementation process of IACOs

The use of IACOs to counter the childhood obesity epidemic is relatively novel; widespread use of these complex interventions only started in the last decade. Hence, research on their implementation process is still in an early stage. No 'golden standard' for IACO process evaluation is yet available, and measures to evaluate possible impeding and facilitating determinants of implementation are scarce and often not statistically validated (53). Current research on the IACO implementation process has furthermore been limited and of varying quality (24,54); Most studies have been performed in one case or setting and do not apply a longitudinal perspective. A preliminary study performed by the Consortium Integrated Approach of Overweight (CIAO) revealed that for individual interventions targeting childhood obesity, high self-efficacy, sufficient knowledge and skills, possibilities for adaptation of the intervention to local needs, procedural clarity (for example of intervention manuals) and visibility of results of the intervention influenced implementation. Moreover, support from management and colleagues, the appointment of an implementation

coordinator and a task orientation compatible with implementation of the intervention were of importance for successful implementation of the intervention (55). If and to which extent these determinants also influence the implementation of IACOs remains to be elucidated.

In conclusion, more research is needed to disentangle the black box of IACO implementation. If the black box of IACO implementation is unravelled, evidence-based strategies for guiding and improving the implementation of IACOs in practice may be formulated. This could potentially optimize the implementation process and in turn, optimize IACO intervention effects.

Aim of this study

To contribute to the disentanglement of the black box of IACO implementation, the overall aim of this study was to examine the implementation process of five EPODE-derived IACO's in the Netherlands. The framework of Saunders *et al*. (37) was used to guide our study design, and the framework of Fleuren (49) to elucidate critical determinants of IACO implementation. This research is a sub study of the research Consortium Integrated Approach of Overweight (CIAO); research aims, concepts and methods used in all sub studies are presented in **Chapter 2**. **Chapter 3** provides an overview of the literature to date on the outcome indicators and determinants of the implementation process of IACOs. **Chapter 4** presents the result of our longitudinal, mixed-method case study the implementation of the EPODE-derived Youth At a Healthy Weight (JOGG) approach in one community in the Netherlands. **Chapter 5** examines the quantitative association between implementation adherence and its determinants using the Measurement Instrument for Determinants of Innovations (MIDI). **Chapter 6** presents the results of our longitudinal, multiple-case study on the process of implementation of five EPODE-derived IACOs in the Netherlands. Finally, **Chapter 7** discusses the result of a longitudinal social network analysis of three communities implementing an EPODE-derived IACOs. Also, the relationship between network analysis parameters and implementation success at the community level is discussed.

Relevance for practice

'Practice what you preach'; A dissertation addressing the implementation of innovations would not be complete without a section elaborating on the practical relevance of its results. To this end, to adoption decision of four professionals from four different sectors towards an IACO are represented below. These cases will reappear in several sections of this dissertation, and the relevance and applicability of our study findings to their day-to-day 'implementation' efforts will be addressed in the discussion.

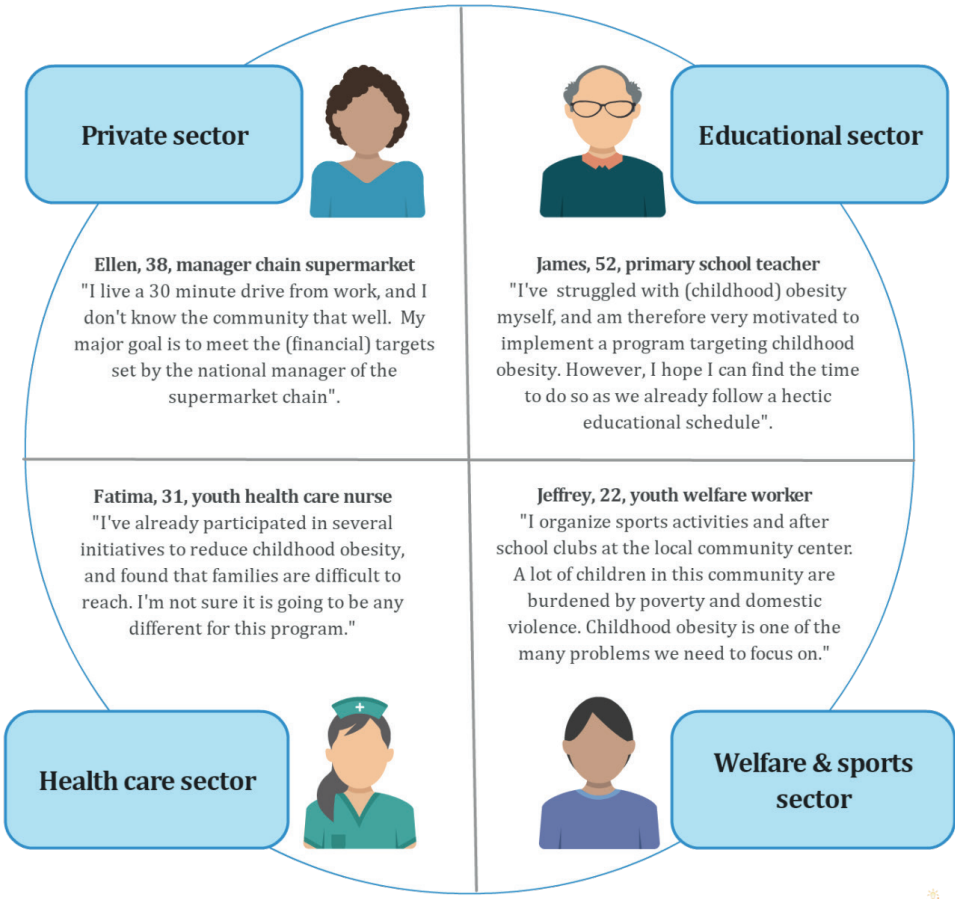

Figure 4. Cases of four professionals implementing an IACO

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Design of CIAO, a research program to support the development of an integrated approach to prevent overweight and obesity in the Netherlands.

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BMC Obesity 2014 19;1:5.

2

Abstract

Background. The aim of this paper is to describe the research aims, concepts and methods of the research Consortium Integrated Approach of Overweight (CIAO). CIAO is a concerted action of five Academic Collaborative Centres, local collaborations between academic institutions, regional public health services, local authorities and other relevant sectors in the Netherlands. Prior research revealed lacunas in knowledge of and skills related to five elements of the integrated approach of overweight prevention in children (based upon the French EPODE approach), namely political support, parental education, implementation, social marketing and evaluation. CIAO aims to gain theoretical and practical insight of these elements through five sub-studies and to develop, based on these data, a framework for monitoring and evaluation.

Methods/Design. For this research program, mixed methods are used in all the five sub-studies. First, problem specification through literature research and consultation of stakeholders, experts, health promotion specialists, parents and policy makers will be carried out. Based on this information, models, theoretical frameworks and practical instruments will be developed, tested and evaluated in the communities that implement the integrated approach to prevent overweight in children. Knowledge obtained from these studies and insights from experts and stakeholders will be combined to create an evaluation framework to evaluate the integrated approach at central, local and individual levels that will be applicable to daily practice.

Discussion. This innovative research program stimulates sub-studies to collaborate with local stakeholders and to share and integrate their knowledge, methodology and results. Therefore, the output of this program (both knowledge and practical tools) will be matched and form building blocks of a blueprint for a local evidence- and practice-based integrated approach towards prevention of overweight in children. The output will then support various communities to further optimize the implementation and subsequently the effects of this approach.

Background

Childhood overweight (and obesity) is one of the most serious public health challenges of the twenty-first century in the world (1). In the Netherlands, the number of overweight children increased sharply in the last decade. In 2010, more than 14% of Dutch children aged between 2 and 21 were overweight, of which almost 2% were obese (2). To stabilize or decrease the current prevalence of overweight, it is widely accepted that interventions should be comprehensive, targeted at multiple levels, address the drivers of overweight and should be directed at children and their environment (3-10). In this paper we will refer to such comprehensive programs as the 'integrated approach'.

The prevalence rates and the severity of overweight, especially regarding complications associated with obesity, put it high on the political and public health agenda of policy makers and funding agencies in the Netherlands. They are becoming increasingly aware that an integrated approach might be the only sustainable solution to this so-called wicked problem of overweight. A wicked problem is defined as a complex problem that prevails in society, with multiple interwoven determinants and for which evidence for the effectiveness of potential solutions is often lacking (11). Driven by the urgency of tackling this extensive and serious public health problem and the growing awareness that the integrated approach might be the only sustainable solution, multiple Dutch municipalities have initiated integrated approaches on overweight and obesity prevention in the last decade (12,13). Additionally, in 2009, the Dutch Ministry of Health recommended an integrated approach based upon the French EPODE program as a possible solution to tackle overweight in The Netherlands (13).

EPODE (or Together Let's Prevent Childhood Obesity) is a French community-wide comprehensive intervention program. It aims to prevent overweight and obesity in children aged 0–12 years and their families through a multi-activity, multi-setting and multi-stakeholder approach (14,15). The program is coordinated at a central level. The focus is on promoting healthy behaviors regarding the importance of healthy eating and regular physical activity (14-16). At the community-level, a project manager is nominated by local authorities. This project manager is not only trained by EPODE, but is also provided with tools and instruments that facilitate local implementation (14). EPODE identified four critical components in its integrated approach: political commitment, public and private partnerships, social marketing and evaluation (14,15).

It is expected that the number of municipalities in the Netherlands that implement an integrated approach will further increase in the coming years since the Minister of Health actively supported the integrated approach by the establishment of the Dutch JOGG central

coordination team in 2010. JOGG stands for Youth on Healthy Weight and is a centrally coordinated and locally implemented integrated approach based on the EPODE approach. In fact, the Dutch government has set the target of the number of cities joining the JOGG programs at 75. In addition to the four critical components of EPODE, JOGG formulated a fifth component: the integrated pathways between prevention and care. The five critical components of the JOGG program are part of a logic model which is shown in Figure 1 (in grey).

To optimize the implementation of JOGG, and subsequently its effectiveness, innovative research is needed. Moreover, local health promotion specialists have indicated that they are in need of tools and guidelines to support the implementation and evaluation of this integrated approach targeting overweight and obesity (17). However, the immediate demand for action by funders and policymakers leaves no time for thorough development of the integrated approach, such as theoretical development, qualitative testing, modelling, feasibility testing etc. Researchers have to adjust their traditional research methods to deliver knowledge and guidelines following the continuous evolution of policy and practice. Action research is specifically recommended to study such programs because it validates the dynamic processes through feedback in order to adjust the approach (18-20). The two main functions of action research are action and evaluation. The action function is supposed to support action and to stimulate the progress of the intervention. It is assumed that this immediate feedback helps practitioners to decide how to continue, thus literally stimulating and guiding action (21). The evaluation function seeks to monitor and ascertain processes and outcomes of interventions or actions. Such an evaluation serves to legitimize a program and increase its accountability.

Consortium integrated approach of overweight

After the Dutch Ministry of Health had mentioned the integrated approach as a possible solution to tackle overweight (13), the research consortium CIAO was established in January 2010. This consortium consists of five Academic Collaborative Centres (ACCs) and aims to gain insight and knowledge in key-elements of the integrated approach towards overweight and obesity prevention.

An ACC is a local collaboration between 3 academic institutions, regional public health services, local authorities and other relevant sectors. Each involved ACC aims to promote knowledge exchange between municipalities, regional Public Health Services, academic public health departments and other local stakeholders on specific public health issues (22,23). This knowledge exchange within an ACC stimulates the translation of scientific knowledge into practical products, services and facilities (22,24). Moreover, it offers a unique opportunity to share processes and methodology for an effective and sustainable

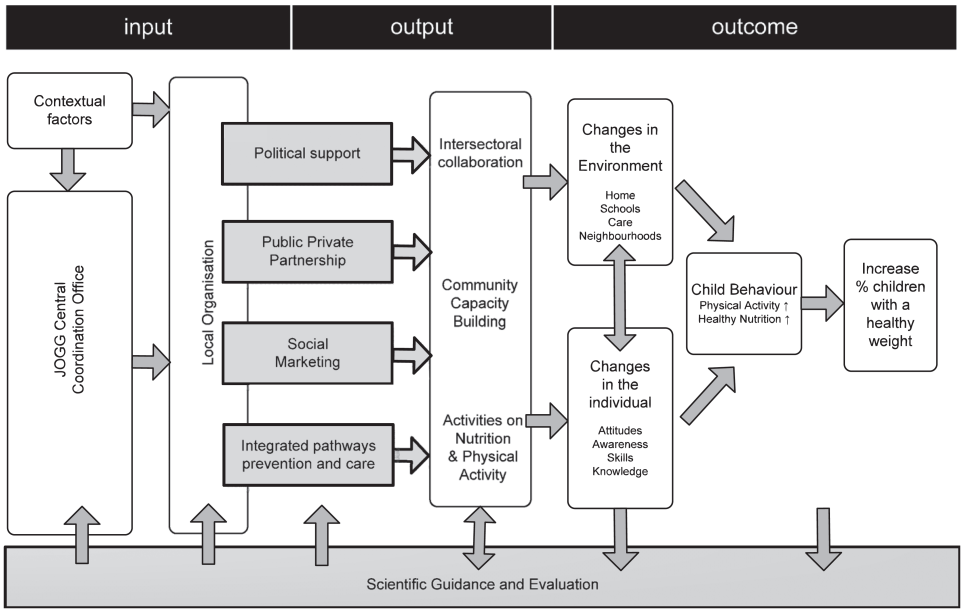

Figure 1 JOGG model. This logic model has been based upon the EPODE logic model (15). It has been developed in the beginning of sub-study 5 by MvK, the JOGG Central Coordination Office and the first six JOGG communities. A clear difference between the two models is the starting point of the four critical components. For the Dutch situation, the developers agreed to move the critical components more to the right of the model, to the local organisation, since development and implementation of these components is mainly at local level. Also a fifth pillar was added to the JOGG model: integrated pathways prevention and care. The JOGG model is being used as a model of reference for implementation and evaluation of the local JOGG approach by JOGG Central Coordination Office and the JOGG communities. Moreover, CIAO uses this model to design and frame its research. The JOGG model has not been published previously.

prevention strategy for overweight at the local level. Through collaboration, researchers can gather complementary evidence that may elucidate the picture as a whole rather than as separate and independent parts. Also the diversity of scientific, tactical and practical knowledge and skills within the ACCs can lead to cross-fertilization and new insights within CIAO. Each of the five ACCs involved in CIAO prioritize the prevention of overweight and obesity.

CIAO started with an inventory study of (inter)national interventions proven effective or promising directed at the primary prevention of overweight and obesity in children and adults and their conditions for successful implementation. Literature studies, surveys and workshops were conducted with health promotion professionals and parents in addition to interviews with experts (25). Also more than 30 interviews were held with health promotion

professionals, policymakers and researchers involved in the five ACCs. The EPODE logic model (15) was used as a framework to guide data-analysis. It appeared that many of the theoretically essential and critical elements of the EPODE approach need further definitions and operationalization (25). For instance, 'intersectoral policy and political commitment', 'social marketing' and 'evaluation' need to be further developed. Additionally, it became clear that currently a lot of potentially effective interventions have been developed to stimulate healthy dietary and physical activity behaviour in families, schools or neighbourhoods, however only a few are implemented in an appropriate and sustainable way. Furthermore, many interventions are applied in a very fragmented way. To reach an effective integrated approach, it is important to work towards more cohesion and intersectoral collaboration. It also became clear that it is necessary to further develop the role of parents in regards to their parenting skills and pedagogical knowledge within different sectors of the integrated approach. This development is especially important within the integrated approach because the participation of parents plays a central role in most interventions especially if young children are involved (26). Finally, many sectors have indicated a need for a comprehensive evaluation framework that can be used to evaluate and monitor the processes and outcomes of the integrated approach (25).

Based on the inventory study, CIAO will continue to further develop a blueprint for a national framework of evidence-and practice-based integrated approach towards local prevention of overweight and obesity. The research program will consist of five sub-studies, conducted by five research teams integrated in the ACCs, which together will constitute the building blocks of such a blueprint. According to both JOGG and EPODE, political commitment is a critical component and is identified by CIAO as a key-element for a successful implementation of the integrated approach. Since determinants of overweight cannot only be found in the domain of public health, but also in other domains such as safety, spatial planning, economics that may influence the physical and/or social environment (more upstream determinants) (27), involvement of these responsible local government sectors is integral in changing these determinants (28). In short, both political commitment and intersectoral collaboration between health and non-health domains are important for the success of an integrated approach (29,30). However, it is still not clear how this can be positively influenced (25,29). Therefore, the first main research question for CIAO is: How can intersectoral collaboration between policy sectors within municipalities result in integrated policies with an effective, easy-to-implement, well-described plan of action?

The reduction of inequalities in health is an important target in public health policies of WHO Europe and the EU. Overweight and obesity are positively correlated to low-income and low education populations, leading to a high prevalence of overweight and obesity in disadvantaged neighbourhoods (31-33). The reach of interventions in these

neighbourhoods is, however, often rather limited. To adapt or develop interventions that connect with the needs, wishes and perceptions of the population in these areas, JOGG should stimulate the use of social marketing strategies. However, the CIAO inventory study revealed that in the Netherlands, social marketing is a relatively new health promotion concept and needs further explication to fully understand the working mechanisms in order to stimulate local use and evaluation (25). Additionally, parental skills and knowledge are key determinants of children's behaviour. To change prevalence rates of overweight and obesity in children by improving energy-balance related behaviours, parental support is crucial (34-36). Existing interventions in the Netherlands focus mainly on behaviour change in children and lack sufficient attention to parental support (25,26). This has led to the second main research question of CIAO: How can current interventions and integrated policies be reinforced by using up-to-date parenting support, and by adaptations increasing the reach in disadvantaged neighbourhoods using social marketing strategies, resulting in effective, easy-to-implement preventive interventions?

Moreover, it is important to gain insight into factors that influence the implementation processes of the integrated approach and interventions, especially in disadvantaged neighborhoods and into strategies to further optimize the use of these factors. Therefore, a thorough monitoring and evaluation of the implementation process is necessary, and process and effect indicators should be routinely measured. For this purpose, it is important that consensus is reached with respect to the indicators that are used to measure the progress and outcome of the integrated approach. The third study question for CIAO to answer is: How can integrated policies be implemented in disadvantaged neighbourhoods, and how can process and effect indicators be routinely measured and applied in the development and implementation of effective local integrated policies promoting healthy weight in youth?

In order to address these questions, CIAO has designed five sub-studies directed at the prevention of overweight and obesity in children:

(1) Guiding and monitoring the process of political commitment for intersectoral collaboration leading to integrated policy,
(2) Influencing reach and effect of community interventions by guiding and monitoring social marketing strategies,
(3) Strengthening parenting styles and practices in existing interventions,
(4) Guiding the intended adoption and implementation processes in an integrated approach,
(5) Developing a theory and practice based evaluation framework.

It is essential that in each of the sub-studies several of the participating ACCs collaborate so that the consortium can optimally benefit from the vast experience and expertise available in these centres. Research will be carried out to improve the program design and implementation of JOGG as it is rolled out.

Methods/Design

All five sub-studies will follow the same research cycle as shown by Figure 2. They will start with an identification phase in which the research question will be specified. In this phase, interviews will be held with experts, parents, health promotion specialists and local stakeholders, and literature search and reviews will be conducted. In the development phase, a framework, theoretical model, tool, or guidelines will be constructed based upon results from the identification phase. In the testing phase, the developed materials will be tested in practice and will be evaluated. Both quantitative and qualitative research methods will be used in this evaluation. In the adaptation and finalization phase, evaluation results from the test phase will be used to adapt and optimize the developed materials. Finally, the developed materials and gained knowledge will be the building blocks for a blueprint for a national framework of evidence-based and practice-based integrated approach towards local prevention of obesity.

The results of the five sub-studies will inform a well-rounded answer to the three main research questions. Research methodology, data-collection, data-analyses and outcomes will be matched and coordinated. To increase understanding and readability, the various sub-studies will be presented here separately (for a concise overview of the sub-studies, see Table 1).

Sub-study 1: Political-administrative support

The aim of this study is to understand the process of intersectoral collaboration leading to an integrated public health policy to prevent childhood overweight and obesity. A multiple-case study design will be used, and a qualitative research approach will be adopted. In this research interviews, online questionnaires and an analysis of policy documents will be used to collect data among several local governmental organizations (i.e., our cases).

In the identification phase, operational criteria of integrated public health policies will be developed by using a literature review and the Behaviour Change Wheel (38) as a theoretical framework. This is required in order to analyze the policy content in the upcoming studies. Furthermore, a conceptual framework, which describes the process of developing integrated public health policies, will be developed by using interviews and theoretical

reflections. Subsequently, interventions for the development of integrated public health policies will be explored by interviewing local governmental officials and key-informants within the policy making process.

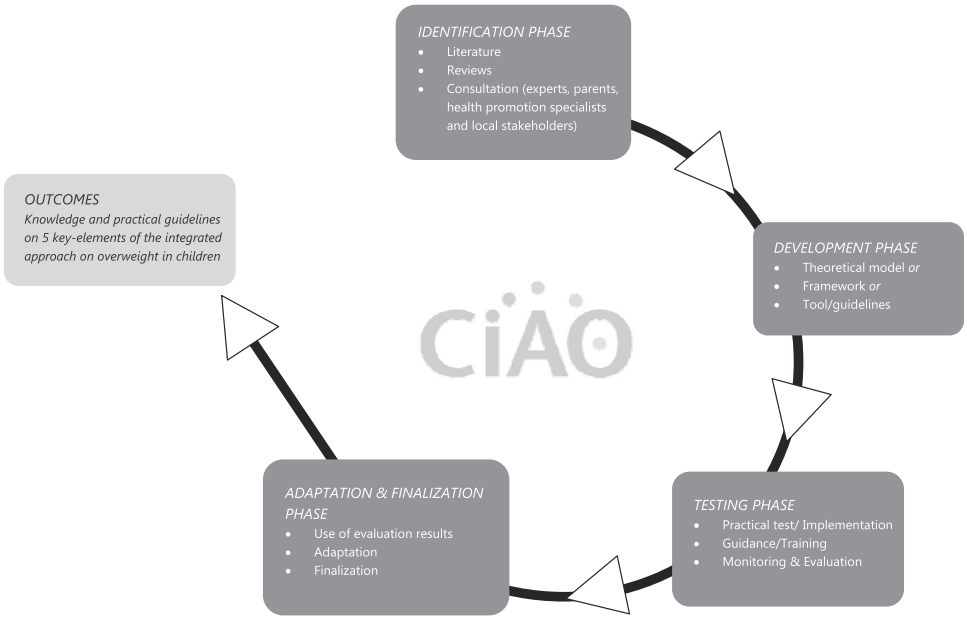

Figure 2. Research outline of CIAO. This figure provides an overview of the four research stages of all the five sub-studies of CIAO.

Interview data will be collected in two small-sized Dutch local governments in the development phase to obtain insight into the factors that were hampering or facilitating intersectoral collaboration. By comparing these cases, insight into the effects of implementation style on interventions aimed at local governmental officials will be derived.

In the testing phase, the conceptual framework will be applied in two relatively large Dutch local governments. The aim is to explore to what extent this conceptual framework might be able to illuminate the process of developing integrated public health policies. Additionally, the definition of integrated public health policies will be used to determine if the policy content of these local governments can be considered 'integrated.' After that, the conceptual framework will be used to evaluate the effect of a resource that was developed in New South Wales, Australia to assist local governments in developing a specific type of integrated public health policy, i.e., an active living policy.

Table 1. A concise overview of the 5 sub-studies of CIAO

Sub-study nr.	Theme	ACC's	Research phases			
			Identification Phase	Development phase	Testing Phase	Adaptation & finalization phase
1	Political-administrative support	Limburg	- Literature review on operational criteria of integrated public health policies	- Develop a conceptual framework which describes the process of developing integrated public health policies.	- Apply developed conceptual framework	- Focus groups with actors at strategic and tactical levels within Dutch local governments to find solutions for previously identified barriers
			- Interviews with local governmental officials and key-informants, and theoretical reflections to gain insight in the process of developing integrated public health policies		- Interviews with local governmental officials to gain insight in hampering or facilitating factors for intersectoral collaboration	- Refinement of the developed conceptual framework based on the outcomes of the previous studies
			- Interviews with key-informants within the policy process to explore existing 'interventions for the development of integrated public health policies'		- Comparison of cases to gain insight in the effects of implementation style on interventions aimed at local governmental officials	- Refinement of the developed conceptual framework based on the outcomes of the previous studies
					Extra: - Test and evaluate the developed framework in Australia (NSW) - data-collection through interviews with General Managers, Directors of Community Services, Health officials and Environment and Recreation officials, and a document analysis.	- Developing a program or policy resource that might be able to stimulate or facilitate the development of integrated public health policies
2	Social marketing	- CEPHIR/Erasmus/ GGD Rotterdam	- Benchmarks	- Monitoring case-studies	- Evaluation of case-studies using developed monitoring format	- Adapting monitoring tool for Dutch setting
			- Analyses of Determinants of healthy weight among children	- Develop practical monitoring tool		- Overview of determinants of applying social marketing

Table 1. (continued)

Sub-study nr.	Theme	ACC's	Research phases			
			Identification Phase	**Development phase**	**Testing Phase**	**Adaptation & finalization phase**
			- Selecting case-studies (interventions to promote healthy weight in childhood based on Social Marketing approach)			
3	Implementation	Noordelijk Zuid-Holland	- Systematic Review of design and quality of implementation research regarding complex integrated programs targeting overweight	- Construction of process evaluation plan & several instruments to evaluate the innovation process	- Longitudinal case-studies (5x): Interviews, questionnaires, focus groups, observational research document analyses & semi-action research social network analysis	- An overview of the level and determinants of the innovation process of the integrated approach
			- Consultation with experts and local project managers		- Parents versus teachers, the relation between task-orientation and implementation	- Guidelines/ indicators for the innovation process
						- If needed, adaptation of framework Fleuren et al (37) (for innovation process of the integrated approach)
4	Strengthening parenting styles and practices in existing interventions	AMPHI Nijmegen	- Analyses existing data: attitudes professionals and parents on overweight	- Development of a web-based parenting intervention (with the aim of strengthening existing overweight preventing interventions in children)	- Testing the effectiveness of this web-based intervention in a two-armed cluster randomized controlled trial	- Web-based parenting intervention to prevent overweight in children
			- Literature search of the role of parenting in interventions to prevent overweight in children	- Development of an 'local pedagogical message regarding overweight and obesity' applicable by all local professionals working with children and their parents	- Focus groups with parents to improve the textual content of the ' local pedagogical message'	- local pedagogical message
			- Analyses of existing interventions for children and attached parental interventions		- Effect and process evaluation of implementation	

Table 1. (continued)

Sub-study nr.	Theme	ACC's	Research phases			
			Identification Phase	Development phase	Testing Phase	Adaptation & finalization phase
			- Focus groups to gain more insight and get specific examples of difficult daily life situations in which mothers experience problems in promoting healthy eating and physical activity among their children			
5	Monitoring & Evaluation	VU University Amsterdam/ Windesheim University Zwolle	- Description of EPODE logic model	- Development of evaluation handbook (1.0) and evaluation tools	- Use of Evaluation Handbook (1.0) by JOGG municipalities	- Adaptation and Finalization of: evaluation handbook (2.0), evaluation planning matrix, evaluation training
			- Evaluation literature	- Development of evaluation training	- Focus groups on evaluation handbook and evaluation training	
			- Interviews with Dutch experts	- JOGG program goals and objectives	- Feedback on evaluation tools and evaluation planning matrix	
			- Comprehensive analyses of evaluation frameworks	- Development evaluation planning matrix	- Data-collection from all CIAO sub-studies inserted in evaluation framework	

Interviews with general managers, directors of community services, health officials and environment and recreation officials and a document analysis of policies developed in the included municipalities will be used to collect data about the policy process and policy content.

In the adaptation and finalization phase, focus groups will be held with actors at the strategic and tactical levels within the three Dutch local governments. The focus will primarily be finding solutions for identified barriers in our previous studies

Sub-study 2: social marketing

Research has shown that community involvement may contribute to improved outcome effects as well as more sustainable programs with better reach and impact (16,39-41). It is argued that to address childhood overweight and obesity, multiple settings need to be targeted (i.e. individual, family, school and community) (42-47). In their brief overview of community interventions and their application to the obesity epidemic, Economos and Irish-Hauser (48) conclude that "involving the community in any of the initiatives helps researchers to pinpoint the specific needs of the community, as well as to identify assets and untapped resources and solutions". This is exactly the idea behind the use of social marketing within health promotion. This study will focus on monitoring and evaluating social marketing techniques applied in programs to promote healthy weight in childhood and to develop a monitoring tool to improve the outcomes of (parts of) programs developed with social marketing. According to French et al., social marketing strategies aim to achieve voluntary behavior change by taking the needs and wishes of the target audience as the starting point and from there, trying to understand how to best promote the desired behavior using an integrated, tailored approach (49). Social marketing strategies aim to incorporate the community and act on an ecological level (50-53), which has led to successful examples worldwide of programs promoting healthy lifestyles among children and their families (54-58).

In the identification phase, public health programs aiming to prevent overweight among children in which social marketing is applied to enhance the outcomes will be explored.

In the development phase, a practical tool or format for monitoring social marketing will be designed This format will be based on theory, e.g. the social marketing benchmark criteria as defined by French (49) and practice, collected data from several case-studies.

In the testing phase, the developed monitoring tools will be tested while evaluating the application of social marketing in the case-studies using quantitative and qualitative methods.

In the adaptation and finalization phase, the lessons learned and insights gained from the testing phase will be used to make the practical format adaptable for practice, possibly for nationwide implementation in the Netherlands.

Sub-study 3: strengthening parenting styles and practices in existing interventions

Following the outcomes of the inventory study of CIAO this sub-study aims to strengthen parenting styles and practices in existing interventions to prevent overweight in children. Therefore, a web-based parenting intervention, an E-learning module will be developed and tested for effectiveness. This E-learning could be added to existing interventions to prevent overweight in children and as such be an integral part of the intervention. Furthermore, a pedagogical message for parents will be developed, which can support them in preventing overweight of their child. All local professionals working with children could use this message.

In the identification phase, a literature search will be carried out regarding the role of parenting in the prevention of overweight in children and the involvement of parents in existing interventions. Furthermore, data from the Youth Health Care on the attitudes of professionals and parents regarding overweight in children will be analyzed. Subsequently, existing data from a large survey of parents (n=7000) on their perception of overweight and the rules parents set at home regarding healthy eating and physical (in)activity will be analyzed (data from a periodical Youth Health Care monitor). More insight into and specific examples of difficult daily life situations in which mothers experience problems in promoting healthy eating and physical activity with their child will be compiled by using focus groups comprised of mothers of different ethnic and socio-economic backgrounds. The Medical Review Ethics Committee Region Arnhem-Nijmegen approved this focus group study, reference number 2012145. This study was not liable for WMO. Written informed consent for participation in the study was obtained from participants.

In the development phase, the outcomes of the identification phase will be used for the development of a Dutch web-based parenting intervention. Thereafter, a Delphi method will be conducted in which we use the knowledge of different experts, researchers and professionals working with children for the development of a pedagogical message regarding overweight and obesity.

In the testing phase, the effectiveness of the web-based parenting intervention will be investigated in a two-armed cluster randomized controlled trial. This trial is in compliance with the Helsinki Declaration. The Medical Review Ethics Committee Region Arnhem-Nijmegen approved the study protocol, reference number 2012495, NL4280309112. This study was not liable for WMO and registered at the Dutch Trial Register NTR3938. A passive

informed consent procedure will be followed in which parents (and their children) can refuse study participation. Thereafter, the usability of the textual content of the pedagogical message will be evaluated by means of focus groups with different ethnic and socio-economic backgrounds.

In the adaptation and finalization phase, the web-based parenting intervention and the pedagogical message will be adapted and optimized according to the findings of the testing phase, and the final versions will be disseminated.

Sub-study 4: implementation of the integrated approach

When preventive programs are being implemented the iterative and dynamic interactions that occur often diverges from the process as originally planned. The integrated approach faces even more implementation challenges as it is based on a convoluted program plan and addresses multiple settings and involves many sectors. During the inventory study, it was concluded that there is limited knowledge of (determinants of) the implementation of the integrated approach. This lack of knowledge makes it difficult to formulate sound implementation strategies and value reported effects of the approach. Therefore, this sub-study will explore the implementation of the integrated approach and its determinants at the community level.

In the identification phase, experts and local project managers of several municipalities initiating the integrated approach will be consulted to identify local implementation plans and strategies to formulate a status quo. Furthermore, a systematic review will be conducted to elucidate what is already known about the implementation of the integrated approach and what instruments and outcome measures have been used to evaluate the implementation process of this approach.

In the development phase, a process evaluation plan will be constructed and several instruments to evaluate the implementation process of the approach will be created or adjusted. This will be guided by the information obtained during the identification phase and by the framework for determinants of innovations as formulated by Fleuren et al. (37). The process evaluation plan will contain mixed-methods for studying the innovation process (i.e. interviews with intermediaries, observations of activities, document analysis, questionnaires, focus groups, network analysis).

In the testing phase, five municipalities in which a longitudinal study will be performed on the implementation process of the integrated approach will be selected. The methods for the process evaluation will be adjusted iteratively when indicated by data-collection and data-analyses.

In the adaptation and finalization phase, the results from the longitudinal study will be combined and compared to create an overview of the level and determinants of the implementation of the integrated approach. Interpretation of data will be based on a framework analysis of qualitative data via Atlas Ti, Qualitative Comparative Analysis, a Social Network Analysis and statistical analysis of quantitative data. Moreover, results of different analyses will be compared to triangulate our data. The process of analysis will lead to a guideline for evaluating the innovation process. Additionally, it will provide implementation indicators that could aid municipalities in formulating implementation strategies for the integrated approach. If needed, the framework of Fleuren et al. (37) will be adjusted to reflect the implementation of the integrated approach.

Sub-study 5: scientific guidance and evaluation

This study aims to construct an evaluation framework for the integrated community approach of overweight and obesity in children in order to stimulate evaluation of JOGG. This evaluation framework will consist of an evaluation handbook set as an action plan in the planning and implementation of evaluation, supporting health promotion specialists to overcome evaluation barriers and in the meantime, build evaluation capacity. The evaluation framework will also consist of an evaluation planning matrix in which practice and evidence based knowledge from the all CIAO sub-studies will be combined. To increase understanding and readability, the methodology for the evaluation handbook will be presented first (A), followed by the description of the evaluation planning matrix (B).

(A) Evaluation Handbook study

In the identification phase, a literature study and interviews with experts, health promotion specialists and JOGG-program managers will be conducted to determine barriers in program-evaluation. Subsequently, a comprehensive search in electronic databases to identify a suitable evaluation action plan or handbook will be conducted.

In the development phase, the identified evaluation handbook will be translated into Dutch. Practice based examples from JOGG communities will be added to this evaluation handbook (version 1.0). Supportive educational training will be developed following the outline of the evaluation handbook. Training will follow essential aspects of the Social Cognitive Theory: modelling, practice, feedback and coaching (59).

In the testing phase, the evaluation handbook will be delivered to JOGG program managers to support evaluation of the local JOGG program. Educational training will be provided to the program managers and involved epidemiologists. Both the training and the evaluation handbook will be evaluated through four focus groups consisting of JOGG program

managers and designated researchers and experts in community-wide intervention approaches and evaluation from research institutes and semi-governmental National Health Promoting Institutes.

Following the outcomes of the focus groups in the adaptation and finalization phase the handbook will be adapted and finalized.

(B) Evaluation planning matrix

An evaluation planning matrix is a tool that describes the evaluation questions, the indicators, data-collection instruments and time-line, data-analyses and dissemination per the main goal.

In the identification phase, the JOGG model will be determined. Subsequently, main goals and objectives of the JOGG-approach will be discussed and determined with the JOGG-board, JOGG central coordination office, six JOGG pilot municipalities and executive researchers of CIAO sub-studies 1,2,3 and 4. Evaluation questions, indicators and data-collection instruments will be delivered by the CIAO sub-studies 1,2,3 and 4.

In collaboration with the other CIAO researchers, in the development phase, these elements will be placed in an evaluation planning matrix.

In the testing phase the evaluation planning matrix will be submitted to experts, program managers and the JOGG central coordination office and evaluated on use, usefulness, and feasibility.

In the adaptation and finalization phase, the evaluation planning matrix will be adapted in accordance with results from the expert meetings and focus groups and disseminated to the JOGG central coordination office.

Both the evaluation handbook and the evaluation planning matrix will be combined in the evaluation framework for the integrated approach on overweight in children. Expert meetings will be held to create consensus and support for the evaluation framework.

Discussion

It is generally accepted that to combat overweight and obesity, an integrated community-wide approach is needed. An inventory study showed that some elements of the integrated approach could be more important than others and that in the Netherlands these elements need further definition and operationalization (25). The concerted research consortium CIAO is expected to contribute significantly to the understanding of these key-elements. This comprehensive study is in line with a recommendation from a recent review study to identify trends and gaps in the field of childhood obesity research done, namely the need for 'more solution-oriented research that combines individual, environmental, and policy strategies to address the problem comprehensively' (60). Collaborating in a research consortium in which researchers gather complementary evidence provides evidence that supports the 'whole' picture rather than parts of it. Also, the diversity of knowledge and skills of the executive researchers and their supervisors working in the ACCs can lead to cross-fertilization that can lead to new insights. In CIAO, this will be stimulated through regular quarterly meetings attended by the executive researchers, their supervisors, the steering committee and also local professionals and stakeholders related to the research topics.

The demonstration of the effectiveness of the integrated approach is beyond the scope and the timeframe of the CIAO collaboration. The effectiveness depends largely on the capacity of local program management, involved local stakeholders, local resources, the severity/prevalence of overweight and the surrounding social and physical environment of the target population. CIAO will help to develop a better understanding of the integrated approach and offer an evaluation framework, including strategies on effectiveness, which may support local professionals in monitoring their program, taking the local context in account. An evaluation framework is important because evaluation can improve local program design which improves the likelihood of achieving successful outcomes (61).

There are multiple challenges in this type of research. CIAO researchers have to take the challenges and solutions of this type of research into account. Nastasi and Hitchcock (2009) conclude in their paper on the challenges of multilevel interventions that "even under relatively controlled experimental or quasi-experimental conditions, many factors can interfere with efforts to carry out well-designed evaluation plans" (62). The first challenge CIAO faces is that its research depends largely on implementation efforts of the municipalities, the communities. Budget cuts or policy changes are a severe threat to CIAO research, due to a possible halt in local implementation.

The second challenge CIAO faces concerns the necessary processes and productive-interactions between the separate research teams. The integrated output of a consortium thrives on the interactions and knowledge exchange between its partners, but these interactions take time. Incentives are provided for individual research publications, but funding is only provided for five four-year research projects, and the additional requirements to establish collaboration between several research teams is not accounted for and so far not acknowledged. Simply stated, the 'glue' between the separate research teams might be missing. Thus, for CIAO to harvest the success of the five ACCs collaborating, all stakeholders involved (executive researchers, supervisors, steering committee, supervisory committee, funders) should acknowledge that integrating group processes and competencies are essential.

The third challenge CIAO will face is 'inaction'. CIAO tries to unravel the blueprint for the integrated approach to show presumable effective elements of this approach. An important reason for this is to allow policymakers, researchers and professionals to understand the drivers and solutions of the wicked problem of overweight and obesity. However, the more thorough a description becomes, and the more it shows the complexity of the chain of causality, 'inaction' might be the result as it raises the difficult question of where action should begin within a highly connected complex system (63).

CIAO research is important because it is the first of its sort in the Netherlands to collect solution oriented evidence in the field of overweight prevention. CIAO aims to find out what processes work best at more upstream environmental levels in an integrated community-wide approach to prevent overweight and obesity. This differs from more traditional social and behavioural sciences that try to demonstrate the efficacy of behavioural interventions to modify health outcomes. The output of the CIAO sub-studies (both knowledge and practical tools) will be matched and form building blocks of a blueprint for a local evidence- and practice-based integrated approach towards prevention of overweight in children. Subsequently, the output will support various communities to further optimize the implementation and subsequently the effects of this approach.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

MvK and JS conceived the idea. MvK was primarily responsible for drafting the manuscript. MvK drafted the two figures and the table. AMH, VvdG, ER, RvdK and MvK wrote the methodology section as executive researcher of their sub-studies and inserted data in Table 1. RvdK, CR, MC, MJ, GM, JSch and JS helped to refine the manuscript and Figure 2. HR was one of the architects of the grant application and contributed to the methodology section of sub-study 2. All authors read, critically revised and approved the final manuscript.

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The implementation of intersectoral community approaches targeting childhood obesity: a systematic review

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Abstract

The implementation of intersectoral community approaches targeting childhood obesity (IACO) is considered challenging. To help overcome these challenges, an overview of the evidence to date is needed.

We searched four databases to identify articles that reported on the determinants of successful implementation of IACOs, resulting in the inclusion of 25 studies. We appraised study quality with the Crowe Critical Appraisal Tool and the Quality Framework; reported implementation outcome indicators were reviewed via narrative synthesis.

Quality of included studies varied. The most frequently reported indicators of implementation success were fidelity and coverage. Determinants related to the social-political context and the organization were most often cited as influencing implementation, in particular, 'collaboration between community partners', 'the availability of (human) resources' and 'time available for implementation'. The association between determinants and implementation variability was never explicated.

We conclude that although some insights into the effective implementation of IACOs are present, more research is needed. Emphasis should be placed on elucidating the relationship between determinants and implementation success. Research should further focus on developing a 'golden standard' for evaluating and reporting on implementation research. These actions will improve the comparison of study outcomes and may constitute the cumulative development of knowledge about the conditions for designing evidence-based implementation strategies.

Introduction

Childhood obesity remains a growing public health concern (1-5). The development of childhood obesity is influenced by multiple determinants originating from diverse contexts (2, 6-8). The use of an intersectoral community approach to address childhood obesity (IACO), including the collaboration of different sectors within the community, has gained support in the literature to adequately address this multifactorial etiology (8-15). Intersectoral collaboration is defined by the World Health Organization as: "…actions affecting health outcomes undertaken by sectors outside the health sector, possibly, but not necessarily, in collaboration with the health sector" (16).

Most IACOs do not show the anticipated intervention effect (15). This lack of effect is often attributed to implementation failure (17, 18). Rogers (19) states that the diffusion of an intervention does not occur spontaneously but moves iteratively through four distinct stages defined as: (a) dissemination, (b) adoption, (c) implementation, and (d) continuation. Evaluation can provide an opportunity for monitoring critical events related to the diffusion process, help identify efficacious program components and support the clarification of factors that facilitate or impede diffusion (20-23). As such, evaluation can disentangle the 'black box' of the IACO diffusion process (24, 25).

An increasing number of articles report on the determinants of the success or failure of IACO diffusion. To our knowledge, some reviews have addressed the diffusion of community-based programs to prevent domestic violence and child abuse (26), injury (27) and cancer (28), but none have focused on the diffusion of IACOs. A comprehensive review of current knowledge could enable professionals to make more evidence-based choices regarding methods and strategies for improving the process of diffusing IACOs. The aim of this study was to review the literature on the determinants of success and failure encompassing all four distinct stages of IACO diffusion. However, a preliminary search of the literature revealed that only a very small number of studies addressed the stages of IACO dissemination and/or adoption (29-31). Because no valid conclusions could be drawn from such a small number of studies, we decided to only review studies that reported on the determinants of the stages of IACO implementation and/or continuation. Moreover, the stages of implementation and continuation appeared to be defined arbitrarily throughout the remaining studies. Additionally, no uniform time interval could be appointed to differentiate initial from continued implementation, which is a common finding in the literature (32, 33). Therefore, we decided to merge both concepts and refer to both phases as 'implementation' in this review.

In conclusion, our study aim is to review the literature that has reported on the determinants of IACO implementation success and failure. We will first describe some general characteristics of the evaluated IACOs (i.e., name, target audience, intervention focus, and location) and of the studies performed (i.e., design, methods, outcome measures, analysis) and appraise all studies on methodological quality.

Methods

This study was performed in accordance with the ENTREQ statement for the synthesis of qualitative research (34).

Primary search strategy

In cooperation with a certified information specialist, we used the 'Sample, Phenomenon of Interest, Design, Evaluation, Research type' (SPIDER) methodology to formulate search keywords. We chose the SPIDER methodology as it is specifically designed to facilitate the search for both qualitative and mixed-method research in the field of public health (35) Next, we developed a PubMed search strategy *(*that was adjusted for equivalent searches in Embase, CINAHL and Psychinfo. Articles published up to December 1st of 2014 were included in our search. Reference manager was used to organize and review the results and duplicate articles found in our search results were deleted.

Secondary search strategy

EPODE and OPIC are the world's largest IACOs and the only two IACOs that are being implemented in multiple countries. Because of their importance, a secondary search in the 'grey literature' was performed if less than two articles reporting on these IACOs could be identified via our primary search. The secondary search was performed in four 'grey literature' databases (SIGLE, WHO database, Grey literature report and BNBRL), in all documents on the major websites of the IACO and via a delimited search in Google. Because the articles/ reports retrieved from the grey literature search are essentially different in setup, outcome indicators retrieved could not be appraised on quality via the CCAT and/or QF instrument. These outcome indicators were therefore not included in the weighted review of indicators. Instead, results of the secondary search were addressed in the paragraph 'grey literature findings' in our result section.

Inclusion criteria

Articles found via our search strategy were assessed on three aspects related to the IACO addressed and three aspects related to the evaluation of the IACO implementation.

Aspects related to the IACO:

1. Intersectoral collaboration and IACO activities
    a) Execution of activities by two or more actors or organizations from different sectors;
    b) At least two activities delivered by professionals from different sectors directly to target population;
2. Target population: Youth (ages 0–21 years) directly or indirectly via parents or caretakers;
3. Target of intervention: At least one determinant of childhood obesity (2);

Aspects related to the evaluation:

4. Study outcomes: Account for indicators (determinants and/or levels of implementation) at the level of the professional (36, 37);
5. Focus of evaluation: Implementation of activities aimed directly at the target population;
6. Type of research and date range: Based on the empirical research, no date range was appointed.

Identification of articles

Screening of title and abstracts as well as full text screening were performed by two reviewers independently (RK and NC). The inclusion of articles was debated in a research group meeting if no consensus about inclusion could be reached. Bibliographies of articles found eligible for inclusion were examined to identify other potentially relevant articles, which were then obtained as full text and screened on the inclusion criteria. Articles that reported on the same IACO were assessed jointly.

Description of articles

Characteristics of the evaluated IACOs were extracted and described. This included the IACO name, its target audience and setting, the sectors involved in the IACO, and its content and focus. Characteristics of the studies such as design, study sample, methods, data analysis, levels of reflexivity, ethics and auditability, outcome measures and reporting were also extracted and described.

Quality appraisal

Articles were appraised on methodological quality. We applied the quality framework (QF) (38) to appraise the qualitative methods. The QF provides opportunity for both technical and theoretical appraisal of the article Also, the QF offers in-depth coverage of relevant quality indicators such as credibility, transferability, dependability, and conformability (39) compared with similar instruments (40, 41). The QF contains nine categories consisting

of 86 sub-items in total, such as "Are the summary or conclusions directed towards the study aims?" and "Were any reflections on the researcher's impact on the research process reported?" Because the QF scoring procedure is not explicitly detailed by its authors, we decided to score each sub-item as 0 (not fulfilled), 0.5 (partly fulfilled) or 1 (fulfilled), assuming equal distances between scoring categories.

Quantitative methods were appraised using the Crowe Critical Appraisal Tool (CCAT), one of the few quality appraisal tools that have been tested for validity and reliability. An extensive user guide is also present for the CCAT, which can optimize inter-rater consistency (42-44). The CCAT contains eight categories with a total of 98 sub-items, such as 'Introduction contains summary of current knowledge' and 'Description present of sample size chosen and why'. Sub-items are scored as either present or not present, but not all sub-items in a category have equal importance. Reviewers are therefore recommended to not only provide an average sub-item score but also score each category separately. Scores per category could range from 0 (lowest) to 5 (highest).

Two researchers (RK and NC) appraised all articles independently using the QF and/or the CCAT. Inter-rater agreement was calculated, resulting in a Cohen's kappa of 0.67 for the CCAT and 0.68 for the QF (45, 46). These kappas are both considered to reflect substantial agreement (46). Discrepancies in scores were discussed until a consensus score for each tool per article was reached. Two senior researchers (PA and MV) each also appraised five articles to verify the validity of the consensus scores. The kappas between the senior researchers' scores and the consensus scores were 0.70 for the CCAT and 0.53 for the QF, suggesting moderate to substantial agreement (46). Discrepancies in scores were mostly attributable to different interpretations of the questions. For example, researchers RK and NC perceived the introduction as adequate when the childhood obesity literature was discussed whereas for senior researchers, this was only the case when the implementation literature was discussed.

Outcomes related to implementing the IACO

A narrative synthesis with a thematic approach was used to extract relevant outcome indicators (47). The thematic approach was mostly deductive, and peer-reviewed models (22, 36) were used to guide the synthesis. First, outcomes indicating the level of IACO implementation were extracted. Comparing the extracted outcomes was challenging because the operationalization of indicators occurred unsystematically in the included articles. To enhance comparability, indicators were classified in accordance with the Peters *et al.* (36, 37) framework on implementation constructs. This framework provides a comprehensive overview of outcome indicators for implementation success used in

health research. Outcome indicators are clustered in eight categories, namely acceptability, adoption, appropriateness, feasibility, fidelity, implementation cost, coverage, and sustainability.

Reported determinants of implementation were extracted and categorized according to the model of Fleuren, Wiefferink and Paulussen (22). This framework visualizes the determinants of program implementation categorized into five subgroups (i.e., characteristics of the sociopolitical context, organization, intended user, innovation and innovation strategies) and has been satisfactorily used in similar reviews (48, 49).

Data extraction was performed by reviewers RK and NC independently; results of the extraction were debated until consensus was reached. For ten articles, the extraction of both the level and determinants of implementation was also performed by a senior researcher (PA or MV). Additions or alterations to the consensus resulting from this validation were small and primarily focused on classification.

Outcome appraisal: The star score system & evidence index

No 'golden standard' on how to incorporate the results of quality appraisal in the systematic review process is yet present (50-52). Some reviews excluded studies obtaining quality appraisal scores below a certain threshold (53, 54). Another review incorporated results of the appraisal via a 'letter grading system', assigning a letter from A to D to each study according to the quality score awarded (55). In line with this letter grading system, we developed a star score system to indicate study quality. We first calculated a quality score (QF and/or CCAT) for each article. The quality score was calculated by dividing the number of points awarded on the appraisal tool by the maximum number of points. A mean score and standard deviation per tool were then calculated. Taken into account the mean score and standard deviation, star scores per tool for each article were assigned. This rating ranged from one star if a quality score was more than one standard deviation below average to four stars if a quality score was higher than one standard deviation above average.

If mixed methods were used, a star score for both the quantitative methods (using the CCAT) and qualitative methods (using the QF) was awarded. We then verified per article which methods were used to evaluate which outcome indicators. If for example only quantitative methods were used to evaluate a specific outcome, quality for this outcome was indicated by the CCAT star score. If mixed-methods were used to identify an outcome, quality was indicated by averaging the star scores obtained on the CCAT and QF

Finally, an evidence index per determinant was awarded by summing the star scores of all articles that reported on the specific determinant. For example, a determinant named by two 1-star studies, two 3-star studies and one 4-star study was awarded an evidence index of ((2*1) + (2*3)+(1*4)) 12 points.

Results

Inclusion of studies

A total of 8441 unique articles were retrieved. Title/abstract screening resulted in the exclusion of 8117 articles, and the full text screening resulted in the exclusion of 284 articles. Both reviewers (RK and NC) agreed about exclusion in the vast majority of cases (>95%). The possible inclusion of 40 articles was further debated during a research group meeting. Two of these articles described results for the same IACO (56, 57) and were assessed jointly. Finally, 26 articles (comprising 25 studies) were found eligible for inclusion (Figure 1). Reasons for exclusion were mostly the lack of intersectoral collaboration in a program, fewer than two activities from different sectors being delivered directly to the target population, or a lack of reporting on the evaluation of an implementation process.

General characteristics of the included studies

The included studies were performed between 1998 and 2013, with 16 out of 25 studies conducted in the last five years (29, 30, 56-71). Sixteen took place in the USA (29-31, 58-61, 64-66, 68, 72-76). Setting(s) of the evaluated programs varied widely; almost half of the studies stated "the community" (31, 58, 61, 64, 66, 71, 73, 76) or school (district) (63, 72, 74, 75) as their primary setting. Three other studies targeted specific ethnic populations and reported specific ethnic settings, including 'tribes' (68), 'pueblos" (59) and 'first nations' (77). Children from specific age categories and their families were frequently targeted (56, 60, 62, 69-72, 74), after the targeting of all ages (31, 67, 73). Most IACOs promoted both physical activity and healthy nutrition (29-31, 58-60, 62-64, 68-72). In addition to this focus on physical activity and healthy nutrition, a number of studies targeted components outside of the traditional obesity prevention scope, such as mental health (67), creating safe environments (65, 73) and education about chronic diseases (77). In 13 IACOs, more than five sectors participated (31, 60, 62-65, 67, 68, 72-74, 77, 78); the education, health and private sectors were most prominently involved.

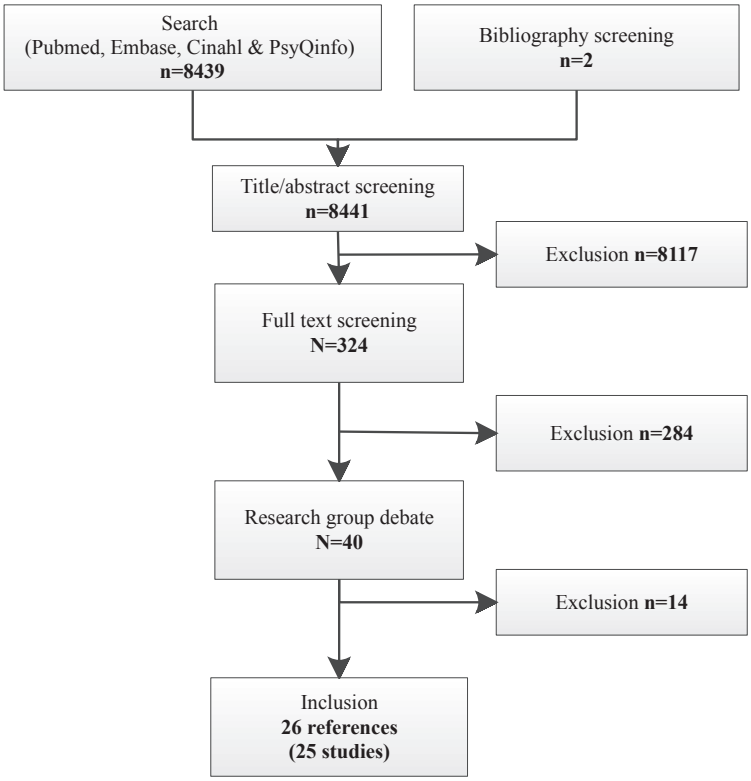

Figure 1. Process of inclusion

Table 1. Characteristics of the evaluated IACOs

Study	Year	Name of intervention	Country	Target audience	Focus	Setting	Sectors involved	# imp
Argrawal *et al.* (60)	2012	Healthy kids, healthy futures	United States	2-12 & parents	PA& N	Program sites	7	4
Davis *et al.* (59)	2013	CHILE (Child Health Initiative for Lifelong eating and Exercise)	United States	Schoolchildren	PA & N	Pueblo (6), community (10)	4	16
Dreisinger *et al.* (29)	2012	Healthy and active communities (H&AC)	United States	Youth & low income individuals	N.s.	Schools (12), communities (11), schools (4),before/ after school programs (4), worksites (3), faith-based organizations (2),hospitals (6)	N.s.	N.s.
Edvardsson *et al.* (56, 57)	2011/2012	Swedish Salut Program	Sweden	0-18 years, parents	PA, N, DC & AC	Municipality	3	13
Fotu *et al.* (62)	2011	Ma'alahi Youth Project (MYP)/ part of Obesity Prevention in Communities (OPIC)	Tonga	11-19 years, family	PA , N	Districts	8	3
Gombosi, Olasin & Bittle (72)	2007	Fit for Life (FFL)	United States	5-14 years &family	PA & N	School districts	5	N.s.
Gomez-Feliciano *et al.* (73)	2009	Active Living by Design	United States	All ages	PA, N & SE	Community	8	1 3
Harris *et al.* (74)	1998	LEAN 5 a day project	United States	4-12 years &parents	N	school	5	3
Huberty *et al.* (31)	2009	Activate Omaha	United States	All ages	PA & N	Community	8	1

Table 1. (continued)

Study	Year	Name of intervention	Country	Target audience	Focus	Setting	Sectors involved	# imp
Karanja *et al.* (68)	2010	TOTS community intervention	United States	0-2 years and parents	PA & N	Tribes (in district)	5	3
Levine *et al.* (61)	2002	Team nutrition	United States	Children	N	Communities	4	7
Mathews *et al.* (63)	2010	It's Your Move! / part of OPIC	Australia	13-17 years	PA & N	Schools	5	5
Middleton, Henderson & Evans (67)	2013	Community based obesity prevention program	England	All ages	PA, N & MH	Program (divers settings, community, school workplace)	8	1
Okihiro *et al.* (66)	2013	Obesity Care Model	United States	<18 years	IOC	Health centre, community	2	1
Pate *et al.* (76)	2003	Active Winners	United States	School grades 5 & 6	PA	Community	3	1
Richards *et al.* (71)	2014	Obesity Prevention And Lifestyle (OPAL)/ EPODE-derived.	Australia	0-18 years	PA & N	Communities	N.s.	21
Rogers *et al.* (58)	2013	Let's Go	United states	Infants- young adults	PA & N	Communities	4	12
Rosecrans *et al.* (77)	2008	ZhiiwaapenewinAkino'maagewin: Teaching to Prevent Diabetes (ZATPD)	Canada	School grades 3 & 4	PA, N & HE	First nations	5	7
Samuels *et al.* (64)	2010	Healthy eating, active communities	United States	Children& adolescents	PA, N & SE	Community	8	6
Schwarte *et al.* (65)	2010	Central California Regional Obesity Prevention Program (CCROPP)	United States	Not specified	PA, N & SE	Sites/counties	7	8
Sekhobo *et al.* (30)	2012	NY Fit WIC (Women, infant, and children)	United States	Children<3& mothers	PA & N	State (110 local WIC sites)	N.s	1

Table 1. (continued)

Study	Year	Name of intervention	Country	Target audience	Focus	Setting	Sectors involved	# imp
Smith *et al.* (78)	2004	The Eat Well SA project	Australia	Children & families	N	South Australia	7	1
Waqa *et al.* (70)	2013	Healthy Youth Healthy Communities/ part of OPIC	Fiji	13-18 years	PA & N	Nasinu area	5	1
Young *et al.* (75)	2008	TAAG (trial of activity for adolescent girls)	United States	Adolescent girls	PA	Middle schools	3	36
Zhou *et al.* (69)	2014	N.s., Multifaceted approach for early childhood physical activity promotion.	China	3-5 years	PA & N	Childcare centres	3	2

PA, physical activity; N, nutrition; N.s, not specified; SE, safe environment; HE, health education; MH, mental health; DC, dental healthcare; AC, antenatal care; IOC, integration of care; #imp, number of implementations studied

Table 2. Study characteristics

Study	Design reported	Design (reviewer)	Methods	Evaluated	Outcomes	Det	Analysis
Argrawal *et al.* (60)	N.s.	Case report	Quantitative: Survey, monitoring Qualitative: Meetings	N.s.	Satisfaction, results achieved	Yes	Quantitative: Calculations Qualitative: N.s.
Davis *et al.* (59)	N.s.	Case report	Quantitative: Forms Qualitative: Semi structured interviews, observations, meetings/ sessions	Implementation	Completion, implementation	Yes	N.s.
Dreisinger *et al.* (29)	N.s.	Case report	Qualitative: Semi structured interviews	Dissemination	None	Yes	Focused coding technique
Edvardsson *et al.* (56, 57)	Before-after Case study	Before-after Case study	Quantitative: Survey Qualitative: Free text questionnaire Qualitative: Semi structured interviews	Implementation Sustainability	Outcome, change Sustainability	Yes Yes	Qualitative: Qualitative content analysis. Quantitative: SPSS descriptive, non-parameter techniques, Wilcoxon signed rank test, McNemar test. Qualitative: Qualitative content analysis.
Fotu *et al.* (62)	N.s.	Case report	Quantitative: Proforma Qualitative: Document analysis	Implementation	Dose, frequency, reach & resource use	Yes	Recorded in Excel
Gombosi, Olasin & Bittle (72)	N.s.	Case report	No methods described	N.s.	Activity executed, people contacted	Yes	N.s.
Gomez-Feliciano *et al.* (73)	N.s.	Case report	No methods described	Implementation	Change	Yes	N.s.

Table 2. (continued)

Study	Design reported	Design (reviewer)	Methods	Evaluated	Outcomes	Det	Analysis
Harris *et al.* (74)	Case report	Case report	Quantitative: Logs, forms Qualitative: Focus groups	Implementation	Implemented as planned, satisfaction	Yes	Quantitative: Counting/ averaging. Qualitative: Identifying themes
Huberty *et al.* (31)	N.s.	Case report	Qualitative: N.s.	N.s.	N.s.	Yes	N.s.
Karanja *et al.* (68)	pre-test/post-test design; before & after design	Case report	Quantitative: Forms, logs	N.s.	Execution of plans	No	N.s.
Levine *et al.* (61)	N.s.	Case report	Quantitative: Survey, activity logs Qualitative: Observations interviews	Implementation	Dose, dose-response relationship, fidelity, practice, level of involvement	Yes	N.s.
Mathews *et al.* (63)	N.s.	Case report	Quantitative: Proforma Qualitative: Interviews, DA, field notes	Implementation, sustainability	Activity process, dose, reach, frequency, resource use	Yes	Entered into access
Middleton, Henderson & Evans (67)	N.s.	Case report	Qualitative: Interviews, focus groups	Implementation	Delivery, provision & receipt	Yes	systematic coding & organizing
Okihiro *et al.* (66)	Report	Case report	Qualitative: Interviews, meetings	Implementation	Integration of care	Yes	N.s.

Table 2. (continued)

Study	Design reported	Design (reviewer)	Methods	Evaluated	Outcomes	Det	Analysis
Pate *et al.* (76)	Quasi experimental design	Case report	Quantitative: Attendance records, surveys, heart rate monitoring Qualitative: Interviews, focus groups, document analysis	Implementation	Implemented as planned, exposure, adherence	Yes	N.s.
Richards *et al.* (71)	Parallel mixed-method study design	Case report	Quantitative: Standardized forms Qualitative: Semi-structured interviews, document analysis	Implementation	Fidelity, adaptation, barriers to implementation	Yes	Quantitative: SPSS, χ^2-test, Cramer's V/φ, standard residual values to determine contribution to χ^2 value. Qualitative: Chen's implementation system model. Sorting based on quantitative results, in- and deductive coding, cross-case analysis. Theme assignment.
Rogers *et al.* (58)	Quasi experimental design	Case report	Quantitative: Surveys	Implementation	implementation	Yes	Assess extent
Rosecrans *et al.* (77)	N.s.	Case report	Quantitative: Completion forms, logs, survey Qualitative: Semi structured interviews	Implementation, sustainability	Reach, dose delivered & received, fidelity, feasibility, acceptability	Yes	Quantitative: Entered into access Qualitative: Read until themes emerged
Samuels *et al.* (64)	Midpoint review	Case report	Quantitative: Survey's Qualitative: Telephone/ computer survey, reports	N.s.	Change in activities/ items sold/ food retail (progress)	No	N.s.

Table 2. (continued)

Study	Design reported	Design (reviewer)	Methods	Evaluated	Outcomes	Det	Analysis
Schwarte *et al.* (65)	N.s.	Case report	Quantitative: Surveys, assessment. Qualitative: Interviews, focus groups	N.s.	Change activities / policy, attitudes, environmental change	Yes	N.s.
Sekhobo *et al.* (30)	N.s.	Case report	Qualitative: Semi structured interviews	Adoption, implementation	Activities implemented	No	Reported in excel, classification in models; Descriptive
Smith *et al.* (78)	Case report	Case report	Qualitative: Document analysis, interviews, focus groups	N.s.	'What happened', reach, effectiveness methods, change, organizational relationships	Yes	Analysed further and categorized, logic model applied.
Waqa *et al.* (70)	N.s	Case report	Quantitative: Pro-forma Qualitative: Document analysis, communication	N.s.	Planning & delivery, processes, reach, frequency, best practice principles	Yes	Quantitative: Entered into Excel, frequency counts Qualitative: N.s.
Young *et al.* (75)	Group-randomized trial	Group-randomized trial	Quantitative: Logs & forms Qualitative: Interviews & observations	Implementation	Reach, dose, fidelity, exposure, acceptability	Yes	Quantitative: Model measures, random effects Qualitative: N.s.
Zhou *et al.* (69)	Pre-test/ post-test study	Case report	Quantitative: Reports, records, surveys	Implementation	Feasibility, fidelity, attendance	Yes	Counting, averaging, further n.s.

Det, determinants reported; N.s., not specified

Quality appraisal of the included studies

Table 3. Quality appraisal scores on the QF

Study	Total (max=86)	Score[a]	Findings	Design	Sample	Data	Analysis	Report	Reflex	Ethics	Audit
Edvardsson *et al.* (57)	72.5		17.5	4.5	9	7	18	8	4.5	3	1
Dreisinger *et al.* (29)	66.5		16.5	4	5	6.5	16.5	7	3.5	5.5	2
Edvardsson *et al.* (56)	64.5	★★ ★★ +1SD	15	3.5	8	6.5	15	7.5	2.5	3.5	3
Middleton, Henderson & Evans (67)	60.5		17.5	5	3.5	4.5	14	7	3	4.5	1.5
Richards *et al.*(71)	54.5		13.5	4	5.5	5.5	10.5	8.5	2	2	3
Sekhobo *et al.* (30)	52		16	3	3.5	7	10	6	3	1.5	2
Rosecrans *et al.* (77)	48.5	★ ★★ Mean	14	4	2.5	6	12	7	2	0	1
Young *et al.* (75)	32		12	4	0.5	3	4.5	3	3	0	2
Pate *et al.* (76)	30		15	1.5	0.5	0.5	3	6	1.5	1.5	0.5
Levine *et al.* (61)	24.5		7	2.5	4	1	6	4	0	0	0
Waqa *et al.*(70)	24.5		9	1	1.5	1.5	4.5	4.5	0.5	1.5	0.5
Fotu *et al.* (62)	23.5		11.5	2	0	0.5	3	5	0.5	0.5	0.5
Harris *et al.* (74)	20.5		8	2	3.5	1.5	1.5	3	0.5	0	0.5
Mathews *et al.* (63)	16.5	★★	6.5	1.5	0.5	0.5	2	5	0.5	0	0
Smith *et al.* (78)	16		10	0.5	0	0.5	2	3.5	0.5	0	0
Samuels *et al.* (64)	13		5	0.5	1	0	1.5	2.5	0.5	2	0
Schwarte *et al.* (65)	13		3.5	0	0.5	0.5	1	2	0	5.5	0
Davis *et al.* (59)	7.5		3	0	0.5	0	1	3	0	0	0
Okihiro *et al.* (66)	6		3.5	0	1	0	0	1	0.5	0	0
Agrawal *et al.* (60)	5.5	★ -1SD	3	0	0	0	0	1.5	0	1	0
Gomez - Feliciano *et al.* (73)	5		2.5	0.5	0	0	0.5	1.5	0	0	0
Huberty *et al.* (31)	4.5		2	0	0.5	0	0.5	1.5	0	0	0

[a]one star, more than one standard deviation below average; two stars, between one standard deviation below average and average; three stars, between average and one standard deviation above average; four stars, more than one standard deviation above average. Cat, category; Max, maximum; SD, standard deviation; Reflex, reflexivity; Audit, auditability.

Table 4. Quality appraisal scores on the CCAT

	Total (max=40)	Score[a]	Preamble	Intro	Design	Sample	Data	Ethics	Results	Discussion
Edvardsson *et al.* (56)	36	★★★★	5	5	4	4	5	4	5	4
Richards *et al.* (71)	31		4	5	4	4	4	3	4	3
Rosecrans *et al.* (77)	28		5	5	4	3	2	1	3	5
Waqa *et al.* (70)	22	★★★ +1SD	3	4	3	1	3	2	3	3
Young *et al.* (75)	22		4	4	4	0	2	2	3	3
Pate et al. (76)	21		3	5	1	1	1	2	3	5
Mathews *et al.* (63)	20		4	3	3	2	1	2	3	2
Zhou *et al.* (69)	20		3	2	3	2	3	2	2	3
Rogers *et al.* (58)	20		3	3	3	2	2	2	1	4
Harris *et al.* (74)	18	★★ Mean	2	1	2	4	3	0	3	3
Levine *et al.*(61)	18		4	3	2	3	2	0	2	2
Karanja *et al.(68)*	13		2	1	2	1	2	4	1	0
Samuels *et al.* (64)	12		3	1	2	0	2	1	0	3
Davis *et al.* (59)	8	★ -1SD	1	2	1	1	1	0	1	1
Agrawal *et al.* (60)	8		0	1	1	0	1	2	1	2
Schwarte *et al.* (65)	6		1	0	0	0	1	1	1	2
Gombosi, Olasin & Bittle (72)	2		0	0	0	0	0	1	0	1

[a] one star, more than one standard deviation below average; two stars, between one standard deviation below average and average; three stars, between average and one standard deviation above average; four stars, more than one standard deviation above average. Max, maximum; SD, standard deviation; Intro, Introduction.

Quality appraisal scores

Five studies were awarded a 4-star rating (29, 56, 57, 67, 71, 77). In contrast with studies awarded a 3-star rating or lower, these studies show especially high scores on report of design, sample selection, data collection and reflexivity on the research process.

Design

A majority of studies (n=14) did not report on their designs or report a rationale for the choice or suitability of the study design (29-31, 59, 60, 62-65, 67, 70, 72, 73, 77). Three studies did not specifically state the name of their design but did elaborate on certain features of the design (29, 67, 77). Four studies reported using a case study or report (57, 66, 74, 78), and two studies reported using a quasi-experimental design (58, 76).

Study sample

The selection of the study sample was not addressed or only briefly addressed in a vast majority of studies (31, 58-60, 62-68, 70, 72, 73, 75-78). Two studies provided information regarding nonparticipation or dropouts in the samples (56, 57, 74). Nineteen studies were awarded low quality scores in the 'sample' category on both the QF and CCAT (30, 31, 58-68, 72, 73, 75-78).

Methods

Of the 22 studies included in the review, 14 reported using mixed methods (56, 59-65, 70, 71, 74-78), six used qualitative methods (29-31, 66, 67) and three used quantitative methods (58, 68, 69). Two studies did not specify the methods used (72, 73).

Approximately three-quarters of the studies used quantitative methods to evaluate implementation indicators, whereas four studies used qualitative methods (30, 66, 67, 78). Solely qualitative methods were used to evaluate determinants of implementation. If qualitative methods were utilized, the most cited technique used was (semi-structured) interviewing (29, 30, 57, 59, 61, 63, 65-67, 71, 75-78). With quantitative methods, authors mostly cited the use of surveys (56, 58, 60, 61, 64, 65, 69, 76, 77), logs (61, 68, 74, 75, 77) and forms (59, 68, 70, 71, 74, 75, 77). No validated questionnaires were used in the included studies.

Seven studies obtained more than half of the quality appraisal points that could be awarded 'for 'methods' (design, sample & data categories) on the CCAT and/or the QF (29, 30, 56, 57, 69, 71, 77). Low scores for 'methods' were mostly attributable to insufficient reporting of procedures or suitability of data collection.

Data analysis

Eleven studies provided details about their analyses of quantitative data (56, 58, 60, 62, 63, 69-71, 74, 75, 77). Two studies reported using univariate analysis (56, 75), and seven studies reported using descriptive statistics, such as 'calculations', 'counting' (58, 60, 69, 74) or entering data into 'Excel' (62, 70) or 'Access' (63, 77).

Ten out of twenty studies that reported using qualitative methods provided specifics of the data analysis (29, 30, 56, 57, 62, 63, 67, 71, 74, 77, 78). Three studies used formalized analysis techniques such as 'cross-case analysis techniques' (71) 'focused coding' (29) and 'qualitative content analysis' (56, 57). The other seven studies provided a general description of analysis but did not theoretically classify the analysis (30, 62, 63, 67, 74, 77, 78). Almost three-quarters of the studies that incorporated qualitative methods scored less than ten out of 20 points in the 'analysis' category of the QF (30, 31, 58-61, 63-68, 70, 72-78).

Reflexivity, ethics and auditability

No studies were awarded a full quality score on the categories reflexivity, ethics and auditability. Particularly for auditability, the level at which the research process was adequately documented, scores were poor.

Outcome measures of implementation

Nearly half of the included studies reported having evaluated the 'implementation' of the IACO (58, 59, 61, 62, 66, 67, 71, 73-76), and three studies reported having (also) evaluated sustainability (57, 72, 75). Nine studies did not specify in which stage in the diffusion process was assessed (31, 60, 64, 65, 68-70, 72, 78), but could be categorized as evaluating the implementation stage as defined by Rogers et al. (19).

A total of 24 outcome indicators for assessing initial and/or continued implementation were reported across studies. 'Dose (received and/or delivered)' (61-63, 75, 77), 'change' (56, 64, 65, 73, 78), 'implementation (as planned) (30, 58, 59, 74, 76) and "fidelity' (61, 69, 71, 75, 77) were most frequently stated as implementation indicators. Determinants of implementation (31, 56-63, 65-67, 69-76, 78) and/or sustainability (57, 72, 75) were also evaluated by a majority of studies. The influence of these determinants on implementation success or failure was not quantified or explicated.

Credibility of findings

Based on the quality appraisal criteria, two-thirds of the included studies provided sufficient detail about the study background (29-31, 56-59, 62-65, 67, 70, 71, 73, 74, 76, 77). The outcomes reported were consistent with existing theories and research context for all 22 included studies. A search for disconfirming evidence or outliers was reported by more than half of the included studies (23, 29, 30, 56, 57, 61-64, 71, 74-77). Six studies provided some description of how importance was assigned to certain data (29, 30, 56, 57, 71, 75, 77).

Indicators of implementation

ified according to the framework of Peters *et al.* (36, 37) (supporting information II-A, II-B and II-C). Twenty-two of twenty-five studies reported indicators that were classified as fidelity, the degree to which the IACO was implemented as intended in the original plans (30, 56, 58-66, 68-78). Twelve studies reported indicators categorized as 'coverage', the degree to which the target population actually received the IACO (31, 61-63, 69, 70, 72, 74-76, 78). Outcome indicators classified as 'acceptability', the perception of professionals that the IACO was indeed agreeable, were reported in seven studies (60, 61, 66, 69, 74, 75, 77).

Fidelity

Levels of reported fidelity differed greatly, and operationalizations were not fully comparable. Furthermore, multiple studies classified fidelity solely based on a summary of activities executed, with no reference to the initial plans. As such, these studies obtained no insight into possible discrepancies between the IACO as intended and the IACO as implemented in practice (30, 59, 60, 62, 63, 70, 72, 73, 77, 78). Fidelity was mostly measured using non-validated surveys, logs or forms.

Coverage

Indicators classified as coverage primarily focused on the number of people who participated in or were reached by the IACO activities. IACO reach ranged from '11 participants per demo' (77) to '6000 children in total' (72). Participation and attendance rates varied between 12% for physical activity components (58) to 100% for participation in school lunch projects (49).

Acceptability

A majority of studies reported that IACO acceptability was high, featuring participant statements such as being 'mostly or very satisfied with the IACO' (44) and materials being 'well received'(66).

Determinants of implementation

Table 5 shows the identified determinants of implementation. For example, the third row displays the determinant 'solid collaboration between community partners' in the first column. The second column shows the number of studies that cited the determinant per star score category. The third column displays the evidence index, which is calculated by summing up the star scores multiplied by the number of studies citing the determinant (i.e. (1*2) + (8*2) + (3*3) + (4*4)= 43). The last column 'direction of influence' indicates if a determinant was cited as a facilitator, barrier or if no direction of influence was stated.

Characteristics of the sociopolitical context

The determinant 'solid collaboration between community partners' obtained the highest evidence index (29, 31, 56-59, 61-63, 65, 67, 69-72, 76-78). This determinant was cited as both a facilitator of and a barrier to implementation; for instance, ' having multiple partners at the table' was described as a facilitator (29), whereas 'difficulty maintaining these partnerships' was mentioned as a barrier to implementation (56). Professionals further mentioned that 'the extent to which the target population was willing to cooperate' influenced the implementation of their IACOs (29, 56, 63, 71, 76, 77). Additionally, 'the absence of a suitable physical environment', for example, the limited availability of healthy foods in stores (77), was frequently noted as a barrier (29, 56, 63, 76, 77). Levels of 'community readiness' and

'community cohesion' as well as 'community advocacy' were cited as both barriers to and facilitators of implementation (29, 31, 62, 63, 65, 73, 76). It is also worth mentioning that as more and more developing countries are facing the problem of childhood obesity, civil unrest can be a barrier to implementation. Fotu *et al.* (62) described that in Tonga, the death of the king partly halted the implementation of their IACO.

Characteristics of the organization

The availability of human and financial resources for implementation was mostly cited to influence the implementation of IACOs (29, 31, 56, 61-63, 65, 67, 69, 70, 76, 77). The nature of resources was not always explicated, but ranged from personnel capacity problems (67, 76) to insufficient budget allocation in schools (63).

Table 5. Determinants of implementation

Determinants of implementation[a]	Evidence index (max=54)	# studies per star score ★ (n=4)	★★ (n=9)	★★ ★★ (n=4)	★★ ★★ (n=5)	Direction of influence: Facilitator (if determinant present)	Barrier (if determinant is not present or exact opposite)	No direction
Social-political context								
Solid collaboration between community partners	**43**	2	8	3	4	(31, 56, 58, 62, 63, 65, 67, 69, 70, 76)	(31, 56, 57, 59, 61, 67, 71, 77)	(29, 72, 78)
Willingness to participate target population	**23**	0	2	1	4	(56, 63, 77)	(29, 56, 63, 67, 71, 76)	
Suitable physical environment / resources available	**15**	0	2	1	2	(56)	(29, 56, 63, 76, 77)	
(Financial) political support for IACO	**14**	1	1	1	2	(63, 75)	(56, 57, 63)	(29, 72)
Community readiness/cohesion/advocacy/ capacity building	**14**	2	4	0	1	(31, 62, 73)	(62, 76)	(29, 63, 65)
Priorities of sectors in community are complementary	**12**	0	2	0	2	(61)	(67, 71)	(78)
IACO fits with existing rules/ regulations	**9**	1	2	0	1	(61, 63)	(71, 72)	
Civil unrest / political issues	**6**	0	1	0	1		(62, 71)	
Integration of services	**5**	1	0	0	1	(67)		(66)
No competing events for IACO	**4**	0	0	0	1		(71)	
IACO differs from approaches already instated in community	**4**	0	0	0	1		(57)	
Community partners are in close geographical proximity	**4**	0	0	0	1	(57)		
Target population feels comfortable about IACO use	**2**	0	1	0	0		(63)	

Table 5. (continued)

Determinants of implementation[a]	Evidence index (max=54)	# studies per star score ★ (n=4)	★★ (n=9)	★ ★★ (n=4)	★★ ★★ (n=5)	Direction of influence: Facilitator (if determinant present)	Barrier (if determinant is not present or exact opposite)	No direction
Organization								
Resources (human/financial) available for IACO	**32**	1	6	1	4	(31, 70, 71)	(29, 56, 61-63, 67, 70, 71, 76, 77)	(65)
Time available to implement (organization/ user level)	**27**	0	6	1	3	(78)	(56, 59, 61, 63, 76, 77)	(29, 67, 70)
Formal reinforcement of IACO use in organization policy/plans	**16**	1	4	1	1	(62, 63)	(57, 63, 69, 70)	(65, 72)
Working towards a shared goal / sharing responsibilities	**10**	0	1	0	2	(56)	(29, 61)	
Limited staff turnover	**6**	0	1	0	1		(29, 59)	
Decision making processes organization(s)	**6**	0	1	0	1		(71)	(61)
Organizational turbulence	**4**	0	0	0	1		(71)	
Solid internal collaboration	**4**	0	0	0	1			(29)
Primary organization user is non-complex	**2**	0	1	0	0		(63)	
Expertise concerning IACO use available in organization	**2**	0	1	0	0		(63)	
User								
Ownership of (subject of) IACO	**19**	1	3	0	3	(63, 67, 73)	(57, 71)	(61, 70)
High motivation of user to implement IACO	**15**	1	2	2	1	(56, 73, 75, 77, 78)	(76, 77)	

Table 5. (continued)

Determinants of implementation[a]	Evidence index (max=54)	# studies per star score ★ (n=4)	★★ (n=9)	★ ★★ (n=4)	★★ ★★ (n=5)	Direction of influence: Facilitator (if determinant present)	Barrier (if determinant is not present or exact opposite)	No direction
User								
Availability of sufficient skills/knowledge to implement IACO	**13**	0	5	1	0	(59, 61, 63, 76)	(62, 63, 70, 76)	
Task responsibility of user complementary with task required to implement IACO	**10**	1	1	1	1	(59, 73)	(56, 57, 59, 77)	
Priority given to implementation IACO i.c.t. priority for other work tasks	**11**	2	2	2	0	(66)	(70, 72, 75, 76)	(59)
Support from higher management for implementation	**8**	0	2	0	1	(56, 57)	(56, 57, 59, 70)	
Support from colleagues for implementation of IACO	**8**	0	2	0	1	(56, 63)	(57, 61)	
Innovation considered valuable by user	**8**	0	0	0	2			(29, 67)
IACO perceived as necessary by user	**7**	1	1	0	1	(57, 72)		(61)
Role in IACO is clear for user	**7**	0	0	1	1		(29, 76)	
Support from other professionals for implementation	**3**	1	1	0	0	(63, 66)		
High self-efficacy to implement IACO	**2**	0	1	0	0	(59)		
Low levels of work-related stress	**2**	0	1	0	0		(63)	
Authority to make changes in working routine	**2**	0	1	0	0	(59)		

Table 5. (continued)

Determinants of implementation[a]	Evidence index (max=54)	# studies per star score ★ (n=4)	★★ (n=9)	★ ★★ (n=4)	★★ ★★ (n=5)	Direction of influence: Facilitator (if determinant present)	Barrier (if determinant is not present or exact opposite)	No direction
Innovation								
IACO is compatible with existing work procedures	**19**	1	4	2	1	(56, 77)	(63, 70, 72, 74-77)	
IACO considered relevant / suitable for target population	**16**	1	2	1	2	(56, 61, 66, 77)	(57, 63)	(29)
Possibility to integrate IACO in daily working routine	**16**	1	4	1	1	(57, 59, 61, 70, 77)		(63, 72)
Implementation of IACO is perceived as advantageous by user	**14**	2	3	2	0	(31, 59, 61, 72, 77)	(70, 75)	
IACO is (cultural) acceptable for user	**13**	0	3	2	0	(75, 77)	(62)	(69, 70)
IACO is considered complete	**13**	0	1	1	2	(57, 74)	(77)	(29)
Results of IACO are observable	**12**	1	2	1	1	(61, 66, 77)	(62, 67, 77)	
Procedures and guidelines are clear for user	**11**	1	3	0	1	(56, 57, 59, 66, 76)	(59, 63)	
Adequate duration/ phase transition of IACO	**10**	0	3	0	1	(59)	(62, 67, 76)	(57)
Quality of IACO intervention materials is considered good	**9**	0	1	1	1			(29, 61, 77)
IACO is appealing to use	**6**	1	1	1	0		(63, 72)	(77)
IACO components are continuously implemented	**6**	0	3	0	0		(63, 76)	(70)

Table 5. (continued)

Determinants of implementation[a]	Evidence index (max=54)	# studies per star score ★ (n=4)	★★ (n=9)	★ ★★ (n=4)	★★ ★★ (n=5)	Direction of influence: Facilitator (if determinant present)	Barrier (if determinant is not present or exact opposite)	No direction
Program topic IACO is highly sensitive for target audience	**6**	0	0	2	0		(56, 63)	
Possibility to adapt IACO to local needs	**6**	0	1	0	1			(29, 59)
IACO matches time of the year (season)	**5**	0	1	1	0		(59, 77)	
Low complexity of / little effort needed to use IACO	**4**	0	2	0	0		(76)	(61)
IACO based on scientific evidence	**4**	0	0	0	1			(29)
Clear programming branding	**4**	0	0	0	1	(57)		
Innovation strategies								
Sufficient time available to design & implement IACO	**23**	2	5	1	2	(57, 66)	(61-63, 71, 77)	(70, 73, 76)
Coordinating staff available for implementation	**21**	1	3	2	2	(29, 61, 62, 73, 75)	(77)	(63, 67)
(Financial) resources made available for implementation	**19**	1	5	0	2	(56, 63, 66, 70)	(61, 62, 70)	(29, 65)
Training provided prior to implementation IACO	**19**	1	4	2	1	(59-61, 70, 75, 76)		(29, 77)
Users involved in development of IACO	**10**	0	1	0	2	(57, 59)		(29)
Opinion leader/champion for IACO is available per organization	**9**	1	2	0	1	(62, 70, 73)	(71)	
Well planned implementation process	**7**	0	2	0	1	(62)		(29, 63)

Table 5. (continued)

Determinants of implementation[a]	Evidence index (max=54)	# studies per star score ★ (n=4)	★★ (n=9)	★ ★★ (n=4)	★★ ★★ (n=5)	Direction of influence: Facilitator (if determinant present)	Barrier (if determinant is not present or exact opposite)	No direction
General support for implementation IACO available	**7**	0	2	0	1	(57, 61)	(61, 76)	
Implementation is regularly evaluated	**5**	3	1	0	0	(31, 59, 73)		(66)
Credit/feedback provided to community about IACO results	**4**	0	0	0	1		(29)	
Information available about IACO use for new employees	**4**	0	0	0	1			(57)
Effective developmental process of IACO	**4**	0	0	0	1		(57)	
Users are reimbursed for implementation of IACO	**3**	1	1	0	0	(63)	(72)	
Implementation plans tailored to organizations	**2**	0	1	0	0		(70)	
Coordinating staff has strong community ties	**1**	1	0	0	0	(73)		

[a] Identified determinants that were outside of the scope of the Fleuren, Wiefferink and Paulussen (22) framework are italicized.

It remained unclear whether (in)sufficient resources were linked to continued implementation of the IACO, as most studies did not explore continuation. Only Huberty *et al.* (31) provided some indication of the presence of this link. They reported that renewal of funding after the ending of a grant aided the continued implementation of their IACO. Next, sufficient available time among professionals was also mentioned as a barrier to implementation (29, 56, 59, 61, 63, 67, 70, 76-78). Another notable finding is that implementation was influenced by the degree to which professionals felt they were working towards a shared goal and shared the responsibility of implementation with colleagues (29, 56, 61).

Characteristics of the user

Whether a professional felt ownership towards the program (57, 61, 63, 67, 70, 71, 73) or was motivated to implement the IACO was frequently cited as a determinant of implementation (56, 70, 73-76). Motivation was often related to other determinants, such as support and feedback (77) Furthermore, the availability of skills and knowledge among professionals to implement the IACO was frequently named as both a facilitator and a barrier (59, 61-63, 70, 76, 77), next to the degree to which the user's task responsibility corresponded with the tasks required to implement the IACO (56, 59, 73, 77). The priority for implementing the IACO in comparison with other work tasks was also reported as a determinant (59, 66, 69, 72, 75). For instance, Gombosi *et al.* (72) reported that teachers did not fully implement the IACO because of competing demands from the state and federal levels; implementing the IACO health curriculum was given a lower priority.

Characteristics of the innovation (IACO)

Multiple studies reported that the compatibility of the IACO with existing working procedures was an influence on the implementation process (56, 63, 70, 72, 74-77). Young *et al.* (75) reported that teachers were required to change their 'standard teaching practices' in order to implement the IACO. Teachers perceived this need for change as a burden, which in turn impeded the implementation of the IACO. The perceived relevance of the IACO for the target population was also frequently cited as a determinant for implementation (29, 56, 61, 63, 66, 77), next to the possibility to integrate the IACO in daily working routine (57, 59, 61, 63, 70, 72, 77), the level to which the professional perceives the implementation of the IACO as advantageous (31, 59, 61, 69, 70, 72, 77) and the perceived completeness of the IACO (29, 57, 74, 77).

Characteristics of the innovation strategies

The determinant 'availability of time to design and implement the IACO' was awarded the highest evidence index in the category 'innovation strategies' (57, 61-63, 66, 70, 71, 73, 76, 77). . The availability of staff to coordinate the implementation process was also stated to

have influenced implementation (29, 61-63, 67, 73, 75, 77). The presence of a coordinator was cited as facilitating implementation, particularly if a full-time coordinator had been appointed (61, 63) who had strong community ties (73). The presence of adequate (financial) resources for implementation was named to influence implementation (29, 56, 61-63, 65, 66, 70), ranging from lack of reimbursement for copy expenses (61) to problems of greater magnitude such as the costs of canteen changes that would have been necessary to implement the IACO (63)., Finally, the provision of training for professionals prior to implementation was stated to have influenced implementation (29, 59-61, 70, 75-77).

Grey literature findings

For EPODE, a secondary search in the grey literature was performed. This resulted in the inclusion of three reports (79-81) and one conference presentation (82). Two outcome indicators categorized as fidelity (79, 82), one categorized as coverage (82) and one categorized as satisfaction (82) were reported. Fourteen determinants were extracted; two determinants were cited by two independent sources, namely 'solid collaboration between community partners' (79, 80) and 'sufficient (financial) political support for IACO' (79, 81). The secondary search confirmed the determinants identified in this review; no new determinants or outcome indicators were identified.

Discussion

The aim of this study was to review the literature that reports on the determinants of IACO implementation success and failure. We identified 25 studies, appraised them on methodological quality and extracted data on the determinants of implementation success and failure via narrative synthesis. The quality of the included studies was appraised as low to moderate, with the exception of five studies that were awarded a four-star rating. These quality ratings underline that research on the implementation of complex health interventions in general (17, 83) and implementing IACOs in specific (56, 84) is still in its infancy. The research included in this review can therefore be considered the work of pioneers who are paving the way for future research and development in this field.

All of the included studies reported having evaluated implementation indicators, and four studies reported having evaluated indicators of continuation. However, no consensus has yet been reached about the distinction between the two stages, for example, about the time interval after which the implementation stage ends and continuation begins (32, 33). This finding resonates in the studies that were included in our review; some considered a time frame of more than one year as the IACO's implementation, whereas other studies considered this to already be continuation. We therefore argue that from a theoretical point

of view our decision to review indicators of both stages jointly is not an optimal solution, but it does provide a best reflection of reality concerning the extent to which IACOs are put into practice. Moreover, as cited in other reviews that have addressed the implementation of various health promotion programs (28, 48), we recommend that future researchers account for all stages in the diffusion process in order to unravel the relative importance of determinants in each stage.

The level of implementation was mostly accounted for by measuring fidelity, acceptability and coverage. As for determinants of implementation, the most evidence was present for determinants related to the social-political context and the organization. The highest evidence index across categories was awarded to the determinant 'solid collaboration between community partners', followed by 'the availability of (human) resources and time' and 'the availability of time to implement the IACO'. No studies explicitly or statistically linked the identified determinants to implementation success.

In short, we succeeded in providing an overview of current knowledge on the determinants of IACO implementation success and failure. However because research is still diverse in quality and design, we are only able to draw tentative conclusions about the critical determinants of implementation success and failure.

Findings compared to previous literature

Previous literature corroborates our conclusion that this field of research is still in its infancy; the use and definition of terminology are not yet standardized (20, 27, 28, 85, 86), and because of the availability and complexity of IACOs, no validated instruments can be used to measure implementation (28, 87). Additionally, our finding that there is room for improvement in the quality of reporting is confirmed by other research (27, 28)

We further concluded that fidelity is the most widely used concept for evaluating IACO implementation success or failure. The same conclusion was drawn by reviews that addressed conceptual use within implementation research (21, 86) and by Peters, Tram and Adam (37), who appointed the concept 'fidelity' an important place in their classification of implementation concepts. Additionally, the unsystematic operationalization and measurement of fidelity in the literature was mentioned in previous studies (88), specifically for community-based interventions (89).

Regarding determinants of implementation, our findings are consistent with the reviews of Tabak *et al.* (90) and Chaudoir *et al.* (91) on theoretical models and indicators of implementation. Additionally, our findings show strong linkage with the study of Hendriks *et al.* (92), who identified determinants of the implementation of integrated health policies

for childhood obesity prevention. Determinants of implementation identified by Hendriks *et al.* (86) partly overlap determinants identified in this review. However, Hendriks *et al.* (86) also identified potential interventions to optimize implementation at the policy level. As for the implementation of IACOs at the community level, few studies have focused on the development of interventions to optimize implementation. We argue that the development of such interventions could improve the implementation of IACOs at the community level, and therefore suggest future research, alongside the elucidation of determinants of implementation, to also focus on the development of such interventions. Furthermore, the framework of Fleuren, Wiefferink and Paulussen (22) proved to be helpful in classifying the determinants that were retrieved in this review; three-quarters of its determinants corresponded with the determinants identified in this review. We also identified determinants that were outside the scope of the Fleuren framework, such as 'community readiness' and 'collaboration with community partners'. This may be explained by the fact that the Fleuren framework was primarily designed to address the implementation of interventions focusing on one setting, whereas this review focused on IACOs that required collaboration between multiple settings. This assumption is corroborated by the fact that the identified determinants that were outside the scope of the Fleuren framework are mostly in line with the review of Stith *et al.* (26) on implementing community-based programs. Together, these findings may suggest that some of the determinants identified in this review are only relevant for interventions that target multiple settings and professionals, such as IACOs.

Although we conclude that the determinants identified in this review largely correspond with determinants reported in previous literature, a comment on this matter is warranted. The studies included in this review used no validated measures, and few articles used structural or theory-based methods to guide the design of their studies. Moreover, the relationship between determinants and implementation success was not tested. As advised by Huijg *et al.* (48) and Palinkas *et al.* (93), we therefore argue that more mixed-methods research that focuses on elucidating the relationship between determinants and implementation success is needed to (dis)confirm the determinants identified in this review.

Strengths and limitations

To our knowledge, this is the first review to address the determinants of IACO implementation success. Moreover, this is the first review on this topic that includes studies containing both qualitative and quantitative methods and that appraises the quality of these studies. The strong emphasis on validating the appraisal, extraction and classification of outcomes may be counted among the strengths of this review. The kappa values obtained, and thus inter-rater reliability, were higher or comparable with the kappa values reported in similar reviews (94-96). This underlines that not only was emphasis placed on validation but also that the validity of the appraisal can be considered fair.

An important limitation of this study is that our search was restricted to four online databases and did not search in additional databases. Although these databases are the largest and usually recommended for reviews, it may be possible that we have missed some evaluations of IACOs. However, our review did include a grey literature search for one of the two largest IACOs being implemented worldwide; the EPODE program (14, 97). Results of this search confirmed the determinants identified in this review; no new determinants or outcome indicators were identified.

Comparison of findings was challenging owing to the unsystematic operationalization of outcome measures. We attempted to overcome these challenges by using peer-reviewed frameworks (22, 36) for a post hoc classification of outcomes. Hereby, we achieved a standardization of the classification process that allowed for a more reliable interpretation and comparison of outcomes.

The use of the 'evidence index' can also be viewed as a strength of this review. Because the comparison of outcomes remained descriptive, the evidence index provided an opportunity to value determinants via the star scoring system. However, the 'evidence index' is not a validated tool for evaluating evidence. Moreover, the rigor of the quality appraisal tools on which the evidence index is based, and therefore their ability to accurately determine a study's methodological quality, is currently being debated (98). Although these matters should be taken into consideration, we are convinced that the use of an 'evidence index' as practiced in this review provided added value to the interpretation and comparison of the outcomes retrieved. We advise future researchers to further develop tools to evaluate the evidence from mixed-methods research.

Conclusion and implications

This review provides a first indication for determinants that are critical for IACO implementation success and failure. However, more research on the process of implementing IACOs is needed to (dis)confirm the findings of this review. We argue that emphasis should be placed on elucidating the relationship between determinants and implementation. Additionally, we suggest that research should continue to focus on the development of validated tools for measuring quality implementation indicators and related determinants. In order to improve the future transparency of methodology and the reproducibility of findings, we further advise researchers to let a peer-reviewed statement such as the STROBE (99) or CONSORT (100) guide their studies. Together, these developments may enhance the establishment of a 'gold standard' for both evaluative methods and guidelines to report on

the IACO implementation process, and, by consequence, broaden and improve the quality of the knowledge base. This, in turn, may facilitate the establishment of evidence-based strategies for guiding and improving the implementation of IACOs in practice.

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A stitch in time saves nine? A repeated cross-sectional case study on the implementation of the intersectoral community approach Youth At a Healthy Weight.

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Abstract

Background. The implementation of programs complex in design, such as the intersectoral community approach Youth At a Healthy Weight (JOGG), often deviates from their application as intended. There is limited knowledge of their implementation processes, making it difficult to formulate sound implementation strategies.

Methods. For two years, we performed a repeated cross-sectional case study on the implementation of a JOGG fruit and water campaign targeting children age 0-12. Semi-structured observations, interviews, field notes and professionals' logs entries were used to evaluate implementation process. Data was analyzed via a framework approach; within-case and cross-case displays were formulated and key determinants identified. Principles from Qualitative Comparative Analysis (QCA) were used to identify causal configurations of determinants per sector and implementation phase.

Results. Implementation completeness differed, but was highest in the educational and health care sector, and higher for key than additional activities. Determinants and causal configurations of determinants were mostly sector- and implementation phase specific. High campaign ownership and possibilities for campaign adaptation were most frequently mentioned as facilitators. A lack of reinforcement strategies, low priority for campaign use and incompatibility of own goals with campaign goals were most often indicated as barriers.

Conclusion. We advise multiple 'stitches in time'; tailoring implementation strategies to specific implementation phases and sectors using both the results from this study and a mutual adaptation strategy in which professionals are involved in the development of implementation strategies.

Keywords: Childhood Obesity, intersectoral community approach, implementation, qualitative methods, process evaluation

Background

A worldwide increase in childhood obesity has been reported over the last decades (1-3). In the Netherlands, an estimated 14% of children have been classified as overweight or obese (1, 4). Obesity often continues during adult life (5) and is linked to numerous adverse health outcomes (6-9). As such, childhood obesity poses a major threat to public health (10), increases health care expenditures and as a consequence, constitutes an economic burden on society (11). Intersectoral community Approaches to address Childhood Obesity (IACO) appear to have great potential to reduce and prevent childhood obesity (12-17). An IACO aims to target the multiple determinants of childhood obesity by involving various stakeholders from within the community (15, 18, 19). An example of a successful IACO that resulted in a decline of childhood obesity is the French 'Ensemble Prévenons l'Obésité Des Enfants' (EPODE) program. The conditions for effectiveness of EPODE are attributed to four center pillars; (a) political and organizational commitment, (b) collaboration between public and private organizations, (c) use of social marketing and (d) the support of scientific evaluation. As a result of its success, several EPODE-derived community approaches were developed (20-22). In the Netherlands, the EPODE-derived JOGG approach (an acronym for Youth At a Healthy Weight, in Dutch) was installed (23, 24).

The innovation process of an IACO can be defined as the iterative cycle of program adoption, implementation and continuation (25). This process is considered challenging; a translational gap between innovation development and implementation is often reported. Systematic insight into the delivery of innovation activities and the implementation of these activities by the intended user population is needed to develop strategies that have the potential to decrease this translational gap. Ultimately, these strategies can optimize the potential impact of the innovation (26-28).

Research on the implementation of interventions often focuses on fidelity: the extent to which an IACO is put into practice (29). One critical aspect of fidelity is completeness, defined as 'the proportion of IACO activities prescribed that is being put into practice' (30). Next to questions regarding completeness, research should also focus on the elucidation of determinants of completeness. Knowledge on these determinants is necessary to develop innovation strategies that have the potential for real change to occur (28, 31-35). Only a dozen studies have specifically addressed the innovation process of IACOs (17, 36). Even fewer studies have evaluated these processes longitudinally. Moreover, the quality of studies performed is not always up to par and determinants found to be critical still need to be (dis)confirmed by future research (37).

As part of a larger study (38), we therefore performed a repeated cross-sectional study on the innovation process of the JOGG "fruit- and water campaign", evaluating both implementation and continued implementation of the campaign. This JOGG campaign took place in a disadvantaged neighborhood in a major city in the Netherlands, and aimed to promote healthy eating and drinking habits in children aged 0-12 years. Campaign strategies, mainly derived from social marketing, consisted of supplying promotional materials and organizing campaign activities such as educational supermarket visits and decorating water cans. Moreover, the campaign aimed issue a positive message to the target population (water and fruit are cool and hip!).

Our research questions were:

1. To what extent were the JOGG fruit- and water campaign activities implemented as intended (completeness) from December 2011 to July 2014?
2. What appeared to be the most critical determinants of the implementation of this campaign?

a. Did determinants differ between the sectors involved (healthcare, educational, sports, welfare and private sector) ?
b. Did determinants of implementation differ in time?

Methods

Design

This study was approved by the ethical committee of the Faculty of Psychology of the University of Leiden, reference number 8259652117. The evaluation was guided by the framework by Saunders *et al.* (27).

Research took place from the start of the campaign in December 2011 until its ending in July of 2014. As suggested by Saunders *et al.* (27) (figure 1), we first performed an inventory of the campaign's setup (t0, research phase A) (figure 2). A blue print of the campaign design, setup and activities was then formulated. The implementation of the campaign was evaluated (research phase B, t1-t5) in five subsequent waves that coincided with 'the booster months' for either the water or fruit theme. For analytical purposes, we considered the first six months of campaigning as initial implementation, followed by mid-way implementation between 7-18 months, and continued implementation between 19-30 months. Thus, if an organization participated in the campaign from the start, initial

implementation was assessed during t1, mid-way implementation during t2 and t3, and continued implementation during t4 and t5. A member check was obtained at t6 (research phase C).

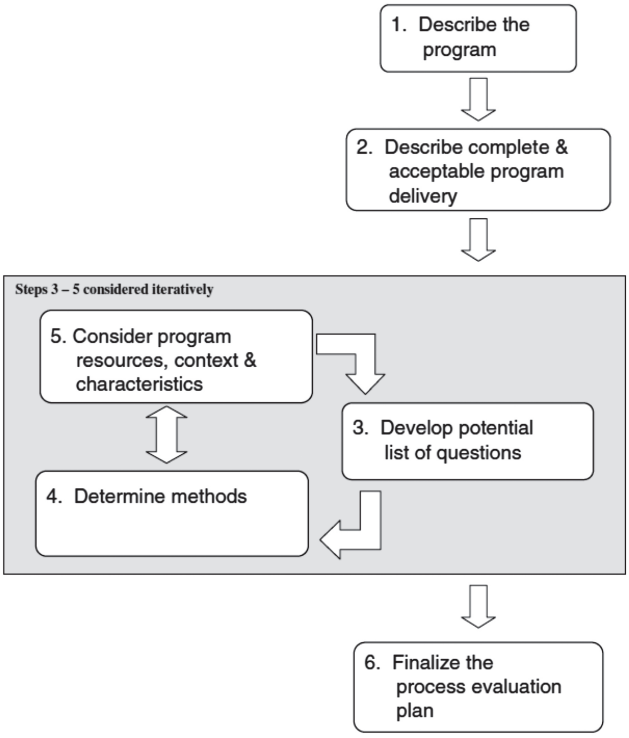

Figure 1. Overview of the framework by Saunders *et al.* (27).

Sample & instruments

All research activities described in the next paragraph were performed iteratively during each research wave. Also, as stated by Saunders *et al.* (27), research instruments were adjusted before each wave following local developments and results of preliminary data analysis. Adjustments consisted, for example, of the addition of items to our interview topic list enquiring on 'new' determinants identified inductively via the preliminary data analysis.

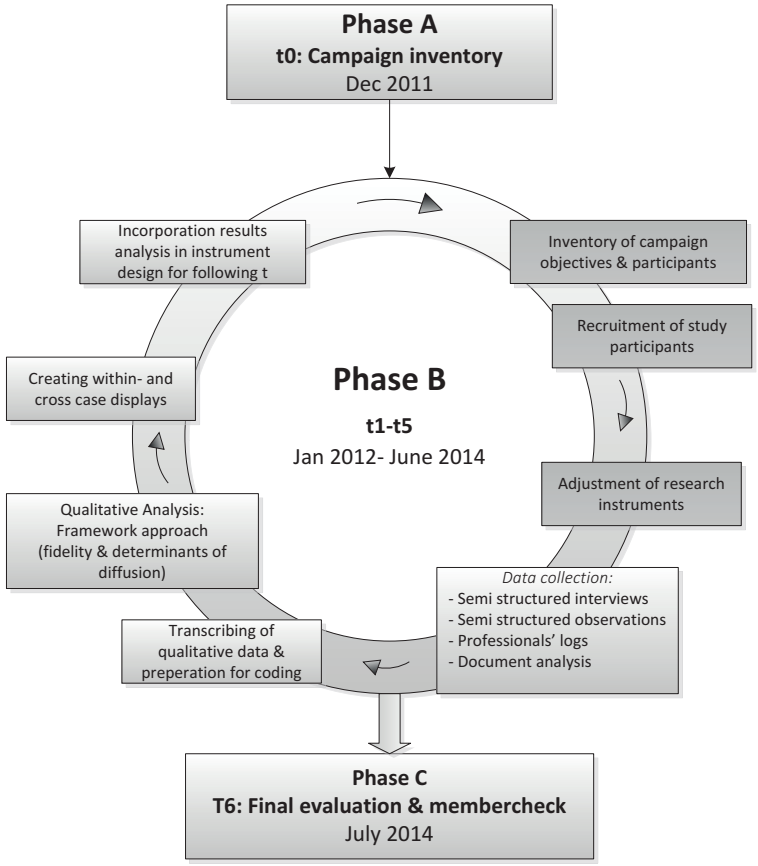

Figure 2 Overview of the research process

At the start of each wave, all organizations meeting inclusion criteria were listed. Inclusion criteria consisted of (a) being situated within community boundaries, (b) receiving financial aid or materials from JOGG and/or (c) organizing activities within the context of JOGG. Via purposeful sampling (39), a selection of professionals working for the listed organizations was invited to participate in our study. Before participation, informed consent was obtained on audiotape from all participating professionals and transcribed verbatim.

To measure completeness (RQ1), prescribed campaign activities per organization were incorporated in observation checklists. If in vivo observation for certain activities was not possible, completeness was evaluated via the semi-structured interview detailed below. The checklist included items like "were fruit moments installed in your organization?" and "Did you organize the prescribed excursion to the local supermarket?". Answers could be either

yes (=1) or no (=0). To evaluate determinants of implementation (RQ2), semi-structured interviews were conducted. The framework of Fleuren et al. (31) was applied as a lead for the selection of interview topics (40-42). This framework distinguishes five major categories of determinants: (a) characteristics of the socio-political context, (b) characteristics of the organization, (c) characteristics of the intended user, (d) characteristics of the innovation and (e) characteristics of the innovation strategies. Interviews were held face-to-face and their duration varied from fifteen tot sixty minutes. Document analysis was performed on planning documents, minutes of campaign team meetings and campaign manager's log entries. Finally, field notes containing both notes from data collection and prejudgments of the researcher were taken into consideration. Our study can be considered as 'semi-action research'; we provided community stakeholders with study results after every wave and encouraged reflectivity. However, we did not advise them how to translate study results into improvements of the campaign. In this way, stakeholders were provided with the opportunity to optimize IACO implementation while keeping the level of data contamination to a minimum.

Analysis

As for completeness (RQ1), all observations checklists were digitalized and transported to Microsoft Excel 2010. The proportion of all prescribed activities that were put into practice was then counted and a standardized score (percentage) per professional was calculated.

Interviews with professionals on the determinants of implementation (RQ2) were transcribed verbatim and transported to Atlas.ti for Windows version 6.2 (Scientific Software development, Berlin). They were then coded separately by two researchers (RK, SA), using a framework approach (43) derived from Fleuren et al. (31). Data analysis was performed after each wave, and at t5 all previous analyses were re-evaluated. Next, data was further reduced by formulating within-cases and cross-cases (44). Within-cases consisted of a narrative and a list of the most important facilitating and impeding determinants per professional. The subsequent cross-cases compared facilitating and impeding determinants per wave, sector and implementation phase. A determinant was classified as a 'key determinant' if it was indicated as a barrier or facilitator by more than 50% of the professionals in the concerning cross-case.

Causal configuration analysis

During cross-case analysis, we found that the determinants were not only self-contained, but seemed to be interrelated and occurring in causal configurations (e.g. presence of determinants A + B + C=> outcome X and presence of determinants B+C+D => outcome Y). We considered using Qualitative Comparative Analysis (QCA) to analyze

these configurations as QCA allows for interrelation analysis when different configurations generate the same outcome (45-48). Moreover, this technique was successfully used to analyze similar configurations by Ordanini, Parasuraman and Rubura (47). Our interviews however were semi-structured; participants did not provide information on exactly the same determinants. We therefore did not have data on the same determinants for all cases. To counter this challenge and at the same time preserve QCA assumptions, we translated QCA principles to a QCA derived causal configuration analysis (figure 3). We identified three outcome categories (low, medium and high completeness). Scores one standard deviation (SD) below the mean were categorized as low completeness, between one SD above and below the mean as medium completeness, and one SD above the mean as high completeness. We also determined sector membership and the implementation phase evaluated per professional. We then identified key determinants via cross-case comparison. After, we explored all possible causal configuration to see if the operator 'or' or 'and' between determinants could be placed (streamlining of conditions). Finally, truth tables were formulated for each possible configuration and a search for conforming and deviant cases was carried out. If contradictory cases were present, we decided that 75% of professionals needed to confirm the configuration to be indicated as a causal configuration of determinants.

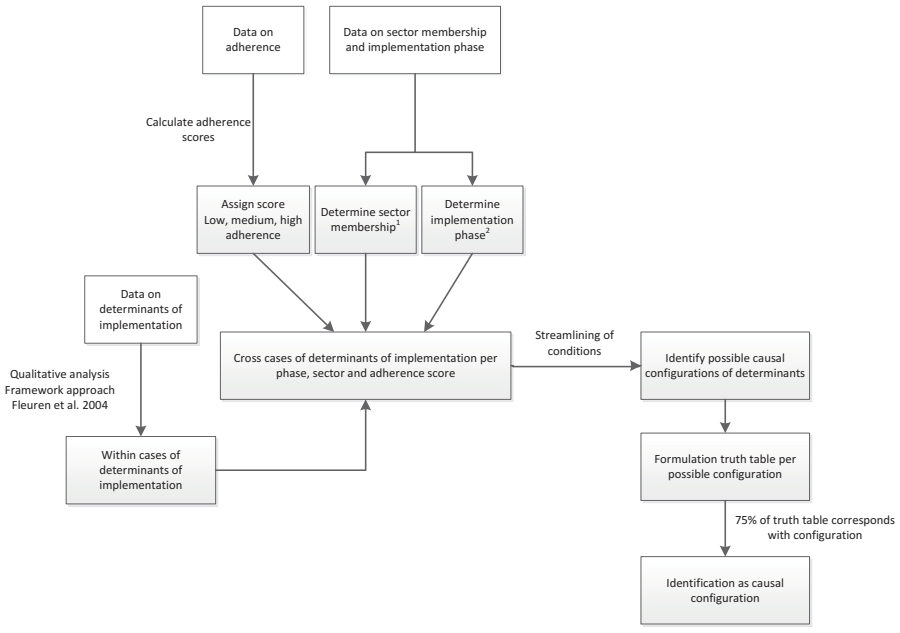

Figure 3. QCA derived causal configuration analysis

Results

Research phase A (t0): Campaign inventory & sample

The fruit and water campaign was part of the national JOGG approach and was financially supported by the local municipality. A campaign manager installed by the Municipal Health Services guided the installment of the campaign, in cooperation with a local campaign team. The campaign was setup as a manualized intervention. However, campaign activities were not prescribed via step-by-step instructions. Instead, activities were prescribed via less formalized instructions such as 'install a water moment' or 'organize an excursion to the local supermarket'. Multiple organizations participated within the campaign, including schools, health organizations and private enterprises. All participating organizations were prescribed campaign activities directed towards the promotion of water and fruit consumption in children. However, the amount and specific content of prescribed activities varied per organization and sector, in accordance with their needs and possibilities. For example, supermarkets were not asked to organize any specific activities for children as they had indicated that insufficient time was available to facilitate such activities. Campaign activities could be divided into key- and additional activities for each sector (table 1). Key activities were hypothesized by campaign management to be crucial for reaching the intended health promotion effect and were intended to be continued by the participating organizations after the end of the campaign. Additional activities were not intended to be continued after the campaign ended.

Our sample achieved reflects the complex and ever changing nature of the campaign; not all organizations could be included during all waves (table 2). This was mostly due to organizations not being prescribed campaign activities or organizations declining (further) participation in the study. Limited time available for data collection by the researchers was also a reason for non-participation. During the study, priority was assigned to those organizations that were prescribed the most campaign activities and/or were considered as most critical for the impact of the campaign. To determine which organizations were most critical for impact, campaign management estimated the number of children that was going to be reached by activities, but also reviewed the content of the prescribed activities. For example, an organization providing a daily water moment during afternoon play activities to a hundred children was prioritized for study participation over an organization that performed a theatre play incorporating a water theme for twenty children on a one day event. Also, a larger number of interviews were conducted during t1 at schools B & C in comparison with school A. This difference was caused by the fact that researchers from an aligned college were conducting an evaluation of fruit- and water consumption at schools B&C at the time of our study.

Table 1. Overview of key and additional campaign activities

Participating organization		Key activities	Additional activities
Educational	Primary schools	- Installment of fruit days & water moments - Teacher leads by example by eating fruit and drinking water - Informing parents about fruit & water consumption	- Distributing promotional materials (e.g. fruit baskets, water cans & crates, coupons for discounts at local enterprises, stickers, posters, banners, window foils, information cards for parents) - Engaging in campaign activities (e.g. the water song, excursions, watching television programs) - Promoting the campaign (displaying posters, banners and information cards) - Involving parents in campaign activities - Organize parent meetings in cooperation with the CJG
Health care	Centre for Youth & Family (CYF) Youth Health Care (YHC) Maternity /infant center	- Motivating target population to increase fruit & water consumption - Providing parents with advice on how to stimulate fruit and water consumption	- Distributing promotional materials - Promoting the campaign - Organize parent meetings in cooperation with schools
Social Welfare	Social Welfare organization Library	- Integration of campaign themes within regular activities - Professionals lead by example by eating fruit and drinking water	- Development of new activities related to campaign themes (e.g. decorating water carafes) - Engaging in campaign activities - Distributing promotional materials - Promoting the campaign
Sports	Sports organizations A& B	- Integration of campaign themes within regular activities - Professionals lead by example by eating fruit and drinking water	- Supplying fruit during sport events in the community - Integration of water theme in the 'sports activity day' for all schoolchildren. - Organizing sport activities for youth related to 'water'
Private	Supermarket, household appliance stores	- Providing fruit free of charge to children - Providing discounts on fruit	- Promoting the campaign - Sponsoring of local activities - Selling campaign material

As they were also qualified to perform qualitative research and were already visiting these schools, they were asked to interview the teachers enquiring on implementation using our interview topic list next to their own study. Hence, additional interviews were thus acquired during t1 at schools B&C.

Table 2. Sample achieved

	T1		T2		T3		T4		T5	
	Int	**obs**	**Int**	**obs**	**Int**	**obs**	**Int**	**obs**	**Int**	**obs**
Educational										
Primary school A	3	2	2	2	2	3	2	2	PD	
Primary school B	7	7	3	2	2	3	2	2	2	2
Primary school C	9	9	2	2	2	3	2	2	PD	
Primary school D	PD		1	1	2	3	2	2	2	2
Health care										
Centre for Youth & Family	1	1	1	1	-	1	1	1	1	1
Youth health services	2	1	3	3	1	1	2	2	1	1
Social welfare and sport										
General welfare organization	1	1	1	1	2	2	1	1	1	1
Library	NP		-	1	Closed due to budget curtailments					
Sports organization A	NP		NP		1	1	0	1	NP	
Sports organization B	NP		NP		1	1	0	1	NP	
Private										
Supermarket A	NP		1	1	1	1	1	1	1	1
Supermarket B	NP		1	1	1	1	1	1	1	1
Household appliance storeA	NP		1	1	0	1	NP		NP	
Household appliance store B	NP		1	1	0	1	NP		NP	
Household appliance store C	NP		1	1	0	1	NP		NP	

Int number of interviews, *Obs* number of observations, *NP* not prescribed campaign activities, *TL* time limitations of researchers, *PD* declined (further) participation in study

Research phase B: Evaluation of implementation (t1-t5)

General findings

Completeness ranged from 0-100% throughout sectors and implementation phases (table 3). Overall, completeness of key activities was higher than for the additional activities The highest levels of completeness were observed in both the educational and health care sector. A majority of organizations showed a notable decline in completeness from t2to t3.

Table 3. Completeness of key- and additional activities.

	T1		T2		T3		T4		T5	
	% Key	% Add	% Key	% Add	% Key	% Add	% Key	% Add	% Key	% Add
Educational										
Primary school A	75	29	54	27	17	4	75	32		
Primary school B	33	24	83	39	100	33	100	64	50	100
Primary school C	63	39	88	39	50	35	42	37		
Primary school D					50	33	75	36	100	100
Health care										
Centre for Youth & Family	100	25	100	75		75	100	80		100
Youth health services	83	43	100	71	67	67	75	75	100	100
Social welfare and sport										
General welfare organization	67	50	0	14	67	17	25	100	100	100
Library			50	50						
Sports organization A					0	0	0	0		
Sports organization B					33	0	0	0		
Private										
Supermarket A			100			100	100	100	100	0
Supermarket B			0			0	100	80	33	0
Household appliance storeA			100	33	0	0				
Household appliance storeB			100	0	0	0				
Household appliance store C			100	0	0	0				

Key Key activities, *Add* additional activities

Table 4. Key barriers & facilitators per sector per implementation phase

	Educational			Health care			Private			Welfare & sports		
	Int	Mid	Cont	Int[a]	Mid	Con	Int	Mid	Cont	Int	Mid	Cont
Key facilitators												
Campaign compatible with existing work procedures	●	●			●	●				●		
possibility to adapt campaign to local needs	●	●					●					●
- ownership for campaign use		●	●		●	●	●	●	●	●		
- self-efficacy for campaign use			●								●	
Uptake of campaign use in daily working routine			●									
Availability of internal campaign coordinator					●							
- support from campaign manager					●					●		
Regular evaluation of campaign implementation					●							
Campaign use cause advantages											●	
Compatibility of campaign goals and goals of organization												●
Key barriers												
- procedural clarity	●						●	●				
Campaign use causes disadvantages	●											
- priority assigned to campaign use		●	●		●							
- durability of campaign materials		●										
Lack of campaign reinforcement strategies			●						●			●
Campaign is considered incomplete					●	●		●				
Chaotic organization of campaign						●				●		
Incompatibility of campaign goals and goals of organization							●					
- participation of target population in campaign								●	●			
High turn-over of staff								●				
Lack of experiencing a shared commitment for campaign use with community partners									●			

Int Initial implementation, *Mid* mid-way implementation; *Con* continued implementation; [a]too little data available to draw conclusions; Determinants outside of the scope of the Fleuren framework are italicized.

Table 5. Causal configurations of determinants

Sector	Phase	Outcome (completeness)	Causal configurations[a]	# cases
Educational	Initial implementation	Medium	Campaign perceived as disadvantageous AND ↓ procedural clarity AND (↑ possibility to adapt campaign to local needs OR ↑ ownership for campaign use OR campaign compatible with existing work procedures)	7 out of 10 cases
	Initial implementation	High	No barriers named AND Possibility to adapt campaign to local needs AND ↑ ownership of campaign use.	2 out of 2 cases
	Mid-way implementation	Medium / High	(↓ priority assigned to campaign use OR ↓ durability of campaign materials) AND Possibility to adapt campaign to local needs AND (↑ ownership for campaign OR campaign compatible with existing work procedures)	9 out of 11 cases
	Continued implementation	Medium	(A lack of reinforcement strategies OR campaign use not included in task orientation) AND (Possibility to adapt campaign to local needs OR ↑ ownership of campaign use OR ↑ self-efficacy)	4 out of 4 cases
	Continued implementation	High	No barriers named AND Uptake of campaign use in daily working routine AND (↑ ownership of campaign use OR ↑ self-efficacy)	5 out of 6 cases
Health Care	Continued implementation	Medium	Campaign perceived as incomplete AND Chaotic organization of campaign AND campaign compatible with existing work procedures	2 out of 2 cases
	Continued implementation	High	A lack of reinforcement strategies AND campaign compatible with existing work procedures AND ↑ ownership of campaign use	2 out of 2 cases
Private	Continued implementation	Low	↓ participation of target population in campaign AND Lack of feeling part of collaboration in community	2 out of 2 cases
	Continued implementation	High	↓ participation of target population in campaign AND Lack of feeling part of collaboration in community AND (perceiving campaign use as personal duty or obligation)	2 out of 2 cases

Table 5. (continued)

Sector	Phase	Outcome (completeness)	Causal configurations[a]	# cases
Welfare	Initial implementation	Medium / High	(↓ procedural clarity OR campaign perceived as incomplete) AND (campaign compatible with existing work procedures OR ↑ ownership of campaign use)	3 out of 3 cases
	Continued implementation	Medium / High	A lack of reinforcement strategies AND possibility to adapt campaign to local needs AND Uptake of campaign use in daily working routine	2 out of 2 cases

[a]Red= barrier, green=facilitator.

Twenty-four key determinants were identified; ten facilitators and fourteen barriers (table4). Overall, high ownership towards campaign goals (feeling psychologically tied or attached to campaign goals (49)) and high compatibility of the campaign with existing working procedures were most cited as facilitators to implementation. Most frequently named barriers were a lack of reinforcement strategies for ongoing use of the campaign (e.g. a training or new promotional materials), a low priority for campaign use, low procedural clarity and incompleteness of campaign materials (e.g. insufficient quantity of campaign materials, campaign lacking classroom teaching materials). Eleven causal configurations were identified across four sectors (table 5); ten configurations were related to a medium to high level of completeness. For the healthcare as well as the educational sector, we identified a causal configuration related to both medium and high completeness for an identical implementation phase. Across these sectors, the facilitators identified in the medium and high completeness configuration were mostly similar, whereas barriers were halved or not present at all in the high completeness configurations. For the private sector, a low and high completeness configuration was identified for continuing implementation. Barriers identified were identical for both low and high completeness, whereas facilitators were only absent in the low completeness configuration. Details per sector on levels of completeness, determinants and configurations are described below.

Implementation per sector

Educational sector

Completeness of key activities in schools varied between 33-75% during initial implementation. Overall, low completeness in schools during initial implementation was associated with a lack of procedural clarity or unforeseen negative experiences during implementation (for example chaos caused by pre-schoolers having difficulties making it to the bathroom).

> We need to plan extra toilet breaks… look, he (student) just peed in his pants and that is just because he drank a lot of water due to the water campaign. *(Teacher school B)*

Throughout mid-way implementation, completeness declined to 50% or less for schools A & C. Teachers from these schools ascribed this decline to the hectic working schedule they followed, which made prioritizing the promotion of a healthy lifestyle difficult.

> We have been so busy the last couple of years, at a certain moment you think 'I don't even know the name of this student in my class'. So I think.. Yes, our main priorities lie elsewhere, not with the water campaign. *(Teacher school A)*

In schools B & D, completeness stayed above 50% during mid-way implementation. This was often attributed to the program's compatibility with pre-existing practices (such as the school schedule) or to the possibility to adapt non-essential elements of the campaign (such as timing of water moments) to their own needs.

During continued implementation, completeness recovered from 17 to 75% at school A and remained above 50% for schools B&D. Recovery of the completeness rate for school A was attributed to the instalment of an coordinator who advised on how to integrate campaign activities in daily routines (such as combining a play-time break with a water moment). Overall, high levels of completeness in continued implementation were associated with high levels of self-efficacy (beliefs about the ability to reach campaign goals).

At school C, completeness stayed below 50% during continued implementation. Teachers from school C often attributed their low level of completeness to the lack of reinforcement strategies available for campaign use, such as the provision of a training or new promotional materials.

> At first, everything was new, they (students) all had their campaign water bottles on their desks and it was very hip and happening! But, yeah, I don't know, it is just not cool anymore now. *(Teacher school C)*

As for causal configurations, during both mid-way implementation and continued implementation professionals displaying high completeness indicated the same facilitators as professionals displaying medium completeness. However, professionals displaying high completeness indicated no key barriers (table 5).

Health care sector

Within the health care sector, completeness of key activities varied from 67-100 %. Professionals stated that compatibility of the campaign with their daily practices facilitated implementation.

> It (the campaign) is now part of my job. So I automatically integrate it into my daily work procedures, this makes the execution easier. *(CYF, nurse)*

Also, the presence of an internal coordinator to assist campaign implementation was named as a facilitator. During continued implementation, incompleteness of campaign materials was named as a key barrier by professionals. For instance, the distribution of campaign materials was often hindered which resulted in too little campaign materials being available.

With regard to configurations, professionals showing medium completeness during continued implementation stated campaign materials were incomplete and the campaign was poorly organized but found that the campaign to be compatible with existing procedures. All professionals displaying high levels of completeness mentioned the campaign to be compatible with existing practices and stated that they felt high ownership towards achieving the campaign goals. However, they cited the campaign lacked reinforcement strategies.

Welfare & Sports sector

For the general welfare organization, a significant decline in completeness of key activities was observed from initial to mid-way implementation. After an initial uplift in completeness (67%), levels declined again to 25% at the beginning of continued implementation but reached a 100% at the end of this phase. Recovery of completeness was mostly attributed to the adaptation of non-essential campaign components to local circumstances and the subsequent uptake of these activities in daily routine.

> It costs quite a lot of time to organize a water or fruit booster. But because we now implement it (campaign activities) during our regular activities, it is working out fine! … we for example organized a community walk yesterday, and we provided children with a healthy snack. So it (campaign objectives) just became a standard procedure. *(Social Welfare Organization, Social worker children)*

Causal configurations revealed that professionals displaying medium to high completeness during implementation all reported that the campaign was incomplete or campaign procedures were unclear, but that they felt highly committed towards the goals to be achieved or found the campaign was compatible with existing work procedures.

Sports organizations showed low completeness (0-33%) during initial implementation, and ceased campaign activities after this phase. This was mostly attributed to the incompatibility of the campaign with existing working procedures and incompleteness of campaign materials. They reported a mismatch between the equipment needed on the sports field (water tanks) and equipment received (water cans). Moreover, they reported that the number of pupils did not equal the promotional materials received and the promotional materials was delivered while the organizations were closed for the winter break.

Private sector

The household appliance stores opted out of the campaign after initial implementation. One supermarket showed a completeness score of 100% during continued implementation, the other supermarket displayed lower levels of completeness (33%). Ownership of campaign goals was cited as a key facilitator in all implementation phases. During initial implementation, the incompatibility of the campaign goals with the goals of the organization was identified as a key barrier.

> I didn't understand the campaign method, I thought the mega fruit cup was a hideous thing, that ruined the image of my shop!. … we have to draw a line somewhere, we are a supermarket and not the extension of municipal programs. *(Supermarket B, manager)*

Not having a feeling of shared commitment with community partners to implement the campaign was cited as a key barrier throughout continued implementation.

> As i have experienced it, the campaign is very standalone instead of coming together with multiple partners and discussing 'what are we going to do about it'? I think this would open a window of opportunities. *(Supermarket A, manager)*

Causal configurations revealed that professionals displaying low completeness during continued implementation stated the participation of the target population was lacking and that they did not experience a shared commitment for campaign use with community partners. Professionals displaying high completeness in this phase also expressed these barriers but stated they perceived campaign use as a personal obligation.

Discussion

The aim of this study was to evaluate completeness of the activities prescribed for the JOGG fruit- and water campaign and to identify the most critical implementation determinants.

Overall, completeness of activities was highest for the general welfare organization, and the educational and healthcare sector organizations. Moreover, completeness was higher for key activities than for additional activities. A decline in completeness was observed for a majority of sports- and private sector organizations after (initial) implementation, and a general decline in completeness was half way the study period. Key barriers identified varied more than key facilitators. High ownership for campaign goals and high compatibility of the campaign with existing procedures were most often cited as facilitators, whereas a lack of reinforcement strategies, a low priority for campaign use, low procedural clarity and incompleteness of campaign materials were most frequently indicated as a barrier. Eleven causal configurations of determinants were identified across sectors and a majority of configurations was related to medium or high levels of completeness.

Implications of findings

Previous research corroborates our findings that levels of completeness differs greatly between sectors and implementation phases (59-61) and that sustainability of IACOs is hard to accomplish (62). The general decline in completeness observed halfway the study period (t3) could be explained by the temporary incapacitation of the campaign manager, in combination with the set-up of the IACO. The water- and fruit campaign was highly manualized and delivered top-down, which has been associated with lower levels of ownership (50). Hence, we argue that in particular in such a top-down implementation approach, the lack of campaign managers' support in combination with this lower levels of ownership could explain the poor IACO sustainability (51). Lack of the support of campaign management or lack of ownership were however not explicitly reported as barriers by the professionals; they solely reported a less orderly campaign organization and incomplete delivery of the campaign materials at t3.

The framework of Fleuren *et al.* (32) proved partly inadequate to identify determinants of implementation of IACOs; seven key determinants identified fell out of the scope of this framework. These determinants, such as 'difficulty to collaborate with community partners' seem to be more specific to the intersectoral, community-based characteristics of IACOs, and are in line with other studies on the implementation of IACOs (36, 52-65). Determinants identified were, to a great extent, sector and implementation phase specific. For example, perceiving campaign implementation as a personal duty or obligation was identified only as a facilitating determinant for the private sector, whereas uptake of the campaign

in daily working routine was only named a facilitator for the educational sector. We therefore argue that implementation plans and strategies should be tailored to sector and implementation phase specific determinants. In addition, adjustments to implementation plans and strategies should be verified and discussed with professionals throughout the implementation process to ensure an optimal fit with the implementation context. This course of action responds to the need expressed by professionals from four out of five sectors to adjust the campaign and its strategies to local needs. This so called 'mutual adaptation approach' provides an opportunity to obtain site-specific feedback from local professionals, and was named in previous studies as a facilitator for institutionalization of health promotion programs (66) and the implementation of complex innovations in cancer care (67).

An interesting distribution of barriers and facilitators was found among the causal configurations identified for the educational and private sector. In the educational sector, the medium and high completeness configurations identified contained mostly identical facilitators. Most facilitators named in these configurations were internal, such 'self-efficacy', 'ownership' and 'task orientation'. The distribution of barriers however differed between these configurations; the medium configuration contained mostly external barriers (such as procedural clarity of the campaign), whereas the high configuration contained no barriers at all. This could imply that, although the same facilitators were present, the absence of certain external barriers could be decisive to achieve implementation success in this sector. For the private sector, barriers identified for both the low and high configurations were similar and mostly external, namely 'low participation of the target population' and 'not feeling part of collaboration in community'. However, an internal facilitator was only present in the high configuration, namely 'perceiving campaign use as personal duty or obligation'. This could imply that, independent of the external barriers present, perceiving the campaign as a personal duty or obligation is a decisive factor for implementation success in the private sector. However, the fact that the barriers named in these configurations were mostly external and the facilitators named were mostly internal could indicate some form of self-serving bias (68) is present in our data. Hence, participants were perhaps inadvertently more prone to erroneously attribute success to internal factors, and failure to external factors.

The casual configurations extracted from our data indicate that a set of determinants can jointly lead to implementation success or failure. We therefore argue 'the whole to be greater than the sum of the parts' and that implementation might benefit more from implementation strategies based on all the configuration determinants combined, than of strategies based on single determinants. Further research testing the effect of such implementation strategies integrating causal configurations in its entirety is warranted to investigate this assumption. Finally, it should be noted that the analysis of causal

configurations in qualitative research is still in its infancy (69). Although, in our opinion, the of use an adapted version of QCA was the best choice to systematically analyze these configurations at this moment in time, readers should keep in mind that no golden standard yet exists and only a limited number of cases were studied. Hence, the reported results should be interpreted with caution.

Strengths & weaknesses

To ensure a systematic, theory-based study design, the framework of Saunders et al. (27) was used to guide our process evaluation. This framework allowed for a sharpened focus in data collection as well as the iterative adjustment of research methods in accordance with (preliminary) results. Although (preliminary) study results were used to adjust research methods, we did not use these results to adjust or improve campaign plans and strategies. Instead, the interaction with practice was guided by a semi-action research design. Hence, we presented the study results to stakeholders after every wave, but did not recommend any changes or alterations to campaign implementation. We chose this approach as to enhance stakeholders' ability to optimize IACO implementation whilst ensuring a minimal level of data contamination. However, although we anticipated that the mere provision of results would encourage practice to optimize implementation plans, due to time limitations and lack of expertise little could be done by campaign management and practioners with the study results provided. We argue that Participatory Action Research (PAR) (70), in which researchers aid practioners with the translation of research findings into implementation strategies, could perhaps enable practice to take optimal advantage of process evaluation data. A review by Cook (71) revealed that PAR led to the translation of research finding into community action in fourteen out of the twenty studies reviewed. The benefits of PAR would therefore, in our opinion, outweigh the possibility of data contamination, which is perhaps partly inevitable when performing IACO process evaluations.

Several other methods were employed to optimize the credibility, objectivity and internal validity of our data (44, 72). We collected data via in vivo observation, in contrast with most implementation studies who merely rely on self-reports (30). Furthermore, data was recorded and transcribed verbatim, analytic software and a framework approach were used for data analysis and further data reduction was performed using theoretically approved methods (44). Also, coding was performed by two researchers and the principal researcher (RK) kept a log about her opinions and prejudgments to increase awareness en reflexivity, reducing moderator bias (73).

One limitation of this study is the selection of participants. Due to the complex and rapidly evolving nature of the campaign investigated, selection of participants was not at random but per opportunity. This makes selection bias possible (74). Also, we could not evaluate

the implementation process of the same individual(s) for every organization at every measurement. This was partly due to 'research fatigue' (75); for example schools stated they already participated in a number of research activities and therefore wanted to spread the 'burden' of study participation by alternating study participation among teachers across measurements. But also the complex and dynamic character of community state of affairs influenced participation; for instance supermarkets showed a high turnover of staff which made it impossible to include the same individual throughout measurements. We countered these sampling issues by ensuring that if the persons included were not similar across measurements, the function or role that the included professionals fulfilled per organization was similar. For example, at schools we always included a teacher from elementary- and middle school, and for supermarkets we always included the floor manager.

Conclusion

This study underlines the complexity of process evaluation of IACOs; the research environment is ever changing and research plans need to be constantly adapted following local developments. Moreover, a participatory action research approach should be considered to enable the swift implementation of study results into practice. Results of this study provide some leads for the formulation of implementation strategies and plans, but more research is needed to (dis)confirm these findings and their generalizability. Tailoring of implementation plans and strategies should be based on a combination of the determinants identified in this study within the context of a mutual adaptation strategy. Hence, 'stitches in time' are needed to allow professionals to complement and verify the tailored strategies developed throughout the implementation process.

Lessons learned

- Research plans need to be adapted iteratively to local developments;
- The translation of research findings into practice could possibly be optimized by the use of participatory action research (PAR);
- A complete, understandable IACO that is compatible with and considered relevant by practice can facilitate IACO implementation
- As some determinants appeared in configuration per sector and phase, implementation might benefit from consideration of these determinants in unity, rather than considering single determinants;
- Implementation plans and strategies should be tailored to sector- and implementation phase specific (combinations of) determinants, and should be based on a mutual adaptation strategy ("stitches in time").

Competing interests

The authors declare that no competing interests are present.

Authors' contributions

RvK, MC, TP and RR conceived and designed the study. RvK was in charge of the data collection, data entry and analysis. TP, MC and RR supervised all stages of the research process. The manuscript was written by RvK; TP, VvdG, MC and RR drafted and revised the manuscript and approved the final manuscript.

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Critical determinants of the implementation of intersectoral community approaches targeting childhood obesity.

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Abstract

Several Intersectoral community Approaches targeting Childhood Obesity (IACOs) have been launched in the Netherlands. Translation of these approaches into practice is however arduous and implementation. We therefore studied the implementation of five IACOs in the Netherlands for one-and-a-half years. IACO implementation was evaluated via an adapted version of the MIDI questionnaire, consisting of 18 theory-based constructs. A response rate of 62% was obtained. A hierarchical multivariate linear regression model was used to analyse our data; the final regression model predicted 65% of the variance in adherence. Higher levels of self-efficacy, being an implementer embedded in community B, and having more than one year of experience with IACO implementation were associated with higher degrees of adherence. Formal ratification of implementation by management and being prescribed a higher number of activities were related to lower degrees of adherence. We advise that, when designing implementation strategies, emphasis should be placed on the enhancement of professionals' self-efficacy, limitation of the number of activities prescribed and allocation of sufficient time to get acquainted and experienced with IACO implementation. Longitudinal studies are needed to further evaluate interaction between and change within critical determinants while progressing through the innovation process.

Keywords: Childhood obesity, implementation, community intervention, intersectoral collaboration

Introduction

Childhood obesity is recognized as one of the greatest health challenges of the 21st century (1-5). Obesity during childhood can result in immediate and future detrimental health outcomes, such as diabetes mellitus type II, cardiovascular disease, cancer and psychosocial problems (6).The etiology of childhood obesity is multifactorial (7, 8). Interventions aimed at reducing childhood obesity should therefore account for determinants at the level of the community, the family as well as the intrapersonal level. In accordance with this rationale, the Intersectoral community Approach to address Childhood Obesity (IACO) 'Ensemble Prévenons l'Obesité des Enfants' (EPODE) was developed in France (9, 10). EPODE builds on evidence that a healthy lifestyle of children can be facilitated and obesity reduced if the current obesogenic environment is changed (11). According to EPODE, these environmental changes can be reached by utilizing its four central pillars, namely political commitment, social marketing, public private partnerships and a science-based evaluation. How these pillars lead to favorable health outcomes in children is illustrated in the EPODE program methodology (12) pictured below (figure 1).

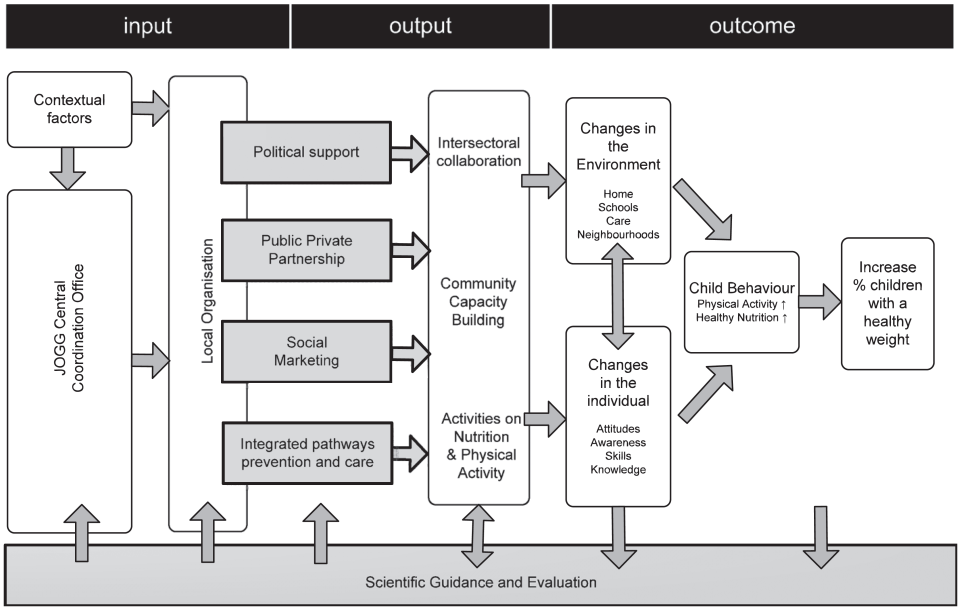

Figure 1. EPODE program methodology, van Koperen *et al.* (10)

EPODE is only partly manualized; communities receive basic instructions and tips from the national coordinating office on how to design and implement an EPODE-derived IACO, but no detailed program plan. Gadgets to stimulate healthy behavior (i.e. water cans, stickers) are also available upon request, but no detailed instructions on how to use them are provided. EPODE utilizes this partly manualized approach as it allows communities to tailor the EPODE program to local community needs. The match between the community needs and the IACO implemented is viewed by EPODE as one of the most crucial factors for program success. Hence, every EPODE derived IACO is based on 'top-down' guidance from the national coordinating office combined with a 'bottom-up' tailoring and mobilization of community resources(10).

EPODE appeared to be successful in reducing childhood obesity in two small villages in France (13). After this success the EPODE methodology was formalized and launched in an international perspective (9, 12, 14). For example, the Australian EPODE-derived IACO OPAL (15) and the Dutch EPODE-derived JOGG approach (16) were instated. After its international dissemination, the effectiveness of EPODE has been shown in various countries, such as the Netherlands (17) and Belgium (18).

Although some studies have shown that IACOs can effectively address childhood obesity, the majority of IACOs implemented has shown only modest impact (19-21). This is often attributed to a translational gap between research (the IACO as intended) and practice (the IACO as executed) (22). The translation of an intervention into practice is a dynamic, non-spontaneous process, often referred to as diffusion of innovation (23). This process can be divided into four main stages: 1) dissemination; the spread of an innovation, 2) adoption; acceptance of the innovation, 3) implementation; the extent to which the innovation is put into practice and 4) continuation. No consensus has been reached in the literature on which time intervals should be appointed to the stages of diffusion. For example when implementation passes into continuation is defined inconsistently throughout implementation studies. We therefore chose to refer to the diffusion process after the adoption decision as implementation.

Evaluation is one of the four center pillars of EPODE. At the moment, research led by van Koperen *et al,* is taken place to formulate an EPODE evaluation framework, detailing what should be evaluated on both the process and outcome level, and how (24). Van Koperen also aims to elucidate if evaluation can be used as a tool to stimulate implementation and in turn, improve intervention effect (25, 26). When our study commenced, such knowledge was not yet available and we therefore drew from the general implementation literature

to formulate an IACO process evaluation plan. In line with Saunders *et al.*(27), we decided to assess both how well the IACO was implemented, and which determinants influenced implementation.

Various constructs are used within implementation research to indicate how well an intervention is implemented (28-31).However, no consensus is yet reached on which combination of constructs should be measured in which studies, and how these constructs should be operationalized (32-37). For example completeness, fidelity, adherence and dose delivered are all referred to, in different frameworks and studies, as 'the extent to which the intervention has been put into practice as intended by its developers' (29, 32, 38, 39). Following the widely used framework of Caroll *et a*l (40), we will refer to the 'proportion of the prescribed intervention activities that is put into practice as intended' as 'adherence'.

Implementation of innovations can be affected by a variety of determinants (32, 41-44). Systematic insight into these determinants is a prerequisite for designing implementation strategies that have the potential to bridge the translational gap between research and practice. Fleuren *et al.* (43) developed an assessment tool which identifies 50 determinants of implementation, categorized into the characteristics that can be attributed to the user, the innovation, the organisation, the innovation strategy and of the socio-political context. The framework is based on standard works in implementation research (23, 45) and an extensive literature review and Delphi study (43). Several other respected frameworks follow a similar categorization (43, 46-48). The Fleuren framework has been successfully applied in a variety of empirical studies (48-51). Based on meta-analyses, Fleuren and colleagues have recently developed the assessment tool MIDI (the Measurement Instrument for Determinants of Innovations) (43, 47). The MIDI can be used to diagnose which determinants affect the implementation of public health innovations and consists of 29 research-based factors. The MIDI has been piloted in several settings (52, 53) and further refinement is still ongoing.

Although the number of studies addressing the implementation process of IACO is increasing, this knowledge is primarily build upon qualitative data. Evidence derived from quantitative methods is still limited (54). We therefore used an IACO-adapted version of the MIDI questionnaire to quantitatively asses implementation of an EPODE derived IACO in five communities, using two subsequent research waves.

Methods

This study is part of a larger mixed-method study on the implementation of EPODE-derived IACOs in the Netherlands, coordinated by the Consortium integrated Approach to Obesity (CIAO) (55).

Design

Survey data were collected in five communities implementing an EPODE-derived IACO between February 2013 and June 2014. In each community, the degree of implementation and related factors were assessed in two waves. The majority of surveys were provided on paper after either (1) a semi-structured interview or (2) observation of the application of an IACO activity in practice. If this was not applicable or inconvenient, the professional was offered the opportunity to complete the questionnaire online via Qualtrics (version 2013, Qualtrics, Provo, UT.)

Outcome variable: Adherence

Adherence was defined as the proportion of all prescribed IACO activities that had been executed in practice. Since the set-up of every IACO was unique, the number and scope of the prescribed IACO-related activities varied per organization (mean number of activities prescribed=19.7, SD=13.7). A list of prescribed IACO activities per organization provided by the local IACO project manager. These activities were incorporated into an organization-specific 'adherence-list'. Items on this list could be answered by the respondents (self-report) with either *'yes'*(1) or '*no*'(2) and could refer to activities such as '*did you provide radish to the children as a snack?*' or '*did you organize an outdoor play activity for the students in the afternoon?*'. An overall adherence score was calculated by dividing the number of activities that were implemented by the total number of activities prescribed, multiplied by a hundred.

Determinants of implementation

The MIDI questionnaire as developed by Fleuren *et al.* (47) enquires on 29 determinants of implementation. To ensure an optimal fit with the communities and IACO studied, three forms of adaptations were made to the original MIDI. These adaptations were informed by preliminary results from our qualitative research. All adaptations were discussed with three senior researchers until consensus was reached (one of them was the co-developer of the MIDI).

The first adaptation consisted of the addition of determinants. We added eight determinants derived from the initial framework of Fleuren *et al.* (43). Thirteen items were added based on preliminary qualitative research in the five communities. Four of these determinants were related to the context, such as 'collaboration between community partners' and 'visibility of IACO implementation in the community'. Four other determinants were related to innovation strategies, such as 'training prior to implementation', 'regular evaluation of the IACO' and 'the use of action planning'. All but one of the determinants added were measured by a single item; only 'ownership' was measured by three items. Items were phrased as suggested by the MIDI, and all were assessed by a 5 point Likert-type scale ranging from 'completely disagree' to 'totally agree'.

The second adaptation consisted of the merging of the original MIDI items 'client satisfaction' and 'client cooperation' into a single item called 'client satisfaction & cooperation', as our qualitative data indicated that satisfaction and cooperation of the target population were almost always intertwined. The third adaptation comprised of a rephrasing of the original MIDI items 'legislation and regulations' and 'performance feedback' so they were optimally tuned to the setting of the IACO implementation. The final adaptation consisted of transforming the original dichotomous yes/no MIDI-items 'formal ratification by management', 'coordinator' and 'turbulence', into 5 point Likert-type scaled items (table 1).

Table 1. Items & constructs of the IACO-adapted MIDI

Category	Construct	Source			Item
		M	F	Q	
Innovation	1. Innovation characteristics				
	a) Completeness	•			The approach provides all the information and materials needed to work with it properly.
	b) Procedural clarity	•			The approach clearly describes the activities I should perform and in which order.
	c) Appealingness		•		The approach is appealing to use.
	d) Quality materials			•	The materials provided to execute the approach are of excellent quality.
	e) Correctness	•			The approach is based on factually correct knowledge.
	f) Complexity	•			The approach is too complex for me to use.
	g) Organization			•	The approach is well organized.
	h) Compatibility	•			The innovation is a good match for how I am used to working.
	i) Adaptability			•	If necessary, i can adapt the approach to fit my own working methods.
	j) Compatibility other interventions			•	The approach is compatible with other obesity prevention programs in this community.
	k) Relative advantage		•		I think implementation of the approach provides advantages to the target population.
	l) Relevance for target population	•			I think the innovation is relevant for the target population.
	m) Observability	•			The outcomes of using the innovation are clearly observable.
User	2. Social influence				
	a) Social support	•			I can count on adequate assistance from my (*colleagues, management, community partners*) if I need it to use the IACO.
	b) Participation target population	•			Which proportion of children will generally participate in IACO activities?
	c) Subjective norm	•			To what extent do (*colleagues, management, community partners, and target population)* expect you to use the innovation?

Table 1. (continued)

Category	Construct	Source			Item
		M	F	Q	
User	d) Descriptive norm	•			In your opinion, what proportion of the colleagues in your organization for whom the IACO is intended actually uses the innovation?
	e) Visibility IACO in community			•	In your opinion, what proportion of the community partners for whom the IACO is intended actually use the innovation?
	3. Information acquisition				
	a) Knowledge	•			I have enough knowledge to use the innovation.
	b) Skills		•		I have enough skills to use the innovation.
	c) Awareness of content	•			To what extent are you informed about the content of the IACO?
	d) Role clarity			•	I know what is expected of me when using the IACO.
	4. Ownership & task orientation				
	a) Professional obligation	•			As a *(occupation)*, I feel it is my responsibility to use this IACO.
	b) Ownership		•		I think the prevention of obesity in children is important.
	c)				I feel committed to the prevention of obesity in children.
	d)				I feel committed to the use of the IACO.
	e) Matching goals		•		The goals of the IACO math my own goals as a *(occupation)*.
	5. Personal benefits	•			Using the IACO provides me personally with more advantages then disadvantages.
	6. Outcome expectation	•			I expect that the approach will contribute to the prevention of obesity in the children I am working with.
	7. Self-efficacy	•			Should you wish to do so, do you think you can put the IACO into practice?
Organisation	8. Prerequisites implementation				
	a) Staff capacity	•			There are enough people in our organization to use the IACO as intended.

Table 1. (continued)

Category	Construct	Source			Item
		M	F	Q	
Organisation	b) Access information innovation use	•			It is easy for me to find information in my organization about using the IACO as intended.
	c) Financial resources	•			There are enough financial resources available to use the IACO as intended.
	d) Material resources & facilities	•			My organization provides me with enough materials and other resources or facilities necessary for the use of the IACO as intended.
	e) Time available	•			I have enough time to include the IACO as intended in my day-to-day work.
	9. Turbulence in organization	•			There are changes in my organization affecting the implementation of the IACO (reorganization, merger, cuts, staffing changes).
	10. Formal ratification by management	•			In my organization, management has set up formal arrangements relating to the use of the IACO (in policy plans, work plans and so on).
	11. Collaboration		•		In my organization, collaboration with colleagues to facilitate implementation of the IACO is solid.
	12. Staff turnover & replacement	•			In my organization, there are arrangements in place so that staff that use the IACO and leave the organization are replaced in good time by employees who are/will be adequately prepared to take over.
Innovation strategies	13. Innovation strategies				
	a) Instruction			•	Before the start of the IACO, I have been provided with clear instructions on how to use the IACO.
	b) Training			•	I have had sufficient training to be able to use the IACO.
	c) Evaluation & feedback	•			In my organization, the use of the IACO is evaluated regularly and feedback is regularly provided about progress with the implementation of the innovation.
	d) Preparation time		•		I have had sufficient time to prepare myself to use the IACO.
	e) Involvement user adoption/ development		•		I have been sufficiently involved in the decision of my organization to use the IACO.
	f) Action planning			•	I have made a clear plan on when and how I'm going to use the IACO.

Table 1. (continued)

Category	Construct	Source			Item
		M	F	Q	
Innovation strategies	g) Coordinator	•			In my organization, a person has been designated to coordinate the process of implementing the IACO.
Context	14. Support municipality/ legislation	•			The activities listed in the IACO fit are supported by existing legislation and regulations from the municipality.
	15. Collaboration community			•	The collaboration with community partners with respect to the IACO is solid.
	16. Physical environment			•	In my community, there are possibilities for children to be physically active (playground, soccer field).
	17. Safety environment for outside play			•	In my community, it is safe for children to play outside or bike/walk to school (heavy traffic, crime).
	18. Role of ethnicity			•	I expect that obese children with one or more parents of non-western descent will benefit more from the IACO implementation.

M; derived from MIDI, F; derived from initial framework Fleuren et al. (101), Q: derived from preliminary results qualitative data.

Sample

Characteristics[a]	Community A	Community B	Community C	Community D	Community E
Size (ha) (municipality/community)	8562 / 428	12874/ 103	2320/184	6958	4250
Inhabitants (municipality/community)	510.320 / 27.095	121.249/ 13.100	180.053/ 7.345	41.005	18.200
Households with low income 2012	61%	56%	59%	35%	34%
% non-western immigrants	54%	25%	17%	4%	6%
Type of IACO	JOGG	JOGG	JOGG	EPODE-derived	EPODE-derived
Set-up of IACO	Mostly top-down	Combination top-down/ bottom up	Combination top-down/ bottom up	Mostly bottom-up	Mostly bottom-up
Type of activities	Mostly nutrition	Combination nutrition/ PA	Moslty PA	Combination nutrition/ PA	Combination nutrition/ PA
Number of PPPs	>5	<5	>5	<5	<5

[a]All numbers on size, inhabitants, household and non-western immigrants was derived from CBS Statline (version 2015, CBS, Den Haag, Zuid Holland)

Inclusion of communities was based on both willingness to participate and optimization of diversity (table 2). The size of communities ranged from 103 ha to 6958 ha; the number of inhabitants from 7.345 to 41.005. Three of the five included communities implemented the JOGG approach, whereas the other two implemented a self-configured EPODE-derived IACO. All of the IACOs included activities promoting Physical Activity (PA) and healthy nutrition in children aged 0-18 years. However, the set-up (top-down vs. bottom up), the number of activities per subject (PA or nutrition) and the number of public-private partnerships (PPPs) differed. Community A, for example, implemented a rather conventional top-down campaign merely focussing on nutrition and included about five PPPs, whereas community E applied a bottom-up strategy with just a few PPPs and a more balanced focus on PA and nutrition.

Participant sampling was performed in each community before both the first and second research wave. The first step in sample selection was to list all professionals who were (a) situated within the physical boundaries of the community and (b) were being prescribed IACO activities that required direct contact with the target population. Next, a selection of professionals from this list was invited to participate. Priority for selection was assigned to professionals that were being prescribed the most IACO activities and/or professionals that were implementing IACO activities that were most crucial to reach IACO's goals according to IACO project management.

Table 3. Characteristics of the included IACOs

Community	A	B	C	D	E
Type of IACO	JOGG	JOGG	JOGG	Other EPODE-derived (own development)	Other EPODE-derived (own development)
Implementation site	Neighborhood	Neighborhood	Neighborhood	Municipality	Municipality
Target audience	0-12 years	0-19 years	0-12 years	0-18 years	0-18 years
Focus	N	PA & N	PA & N	PA & N	PA & N
IACO activities per sector					
Educational	Fruit and water campaign: *installment of fruit & water moments, informing parents about N.*	Gardening & healthy nutrition program preschools	Integrated, multidisciplinary school health program (Lekker Fit!)	Integrated, multidisciplinary school health program School nutrition policies Preschool PA & N policies	Integrated, multidisciplinary school health program
Health Care	Fruit and water campaign: *motivating youth in medical consultations to increase fruit/water intake, advising parents*	Nutrition decision making/ 'resilience' program	Children's physical therapy 'toddler gym'	Children's physical therapy 'toddler gym'	-
Welfare & sports	Fruit and water campaign *Integrating healthy PA & N into existing activities, gadgets distribution*	Municipal PA & N'stimulation & connecting' program	Integrated 'active communities' PA program Free running	Afterschool sport activities PA & N activities local welfare organization	Walk & run together community PA program 'Try a sport you like' community PA program
Private	Fruit and water campaign *Providing fruit and water free of charge, sponsoring of activities*	Sponsoring of PA & N activities	'Making-soup' healthy nutrition activity Sponsoring of PA & N activities (e.g. funding school playground)	Supermarket visits (part of school health program) Football club initiated PA activities (part of school health program)	Supermarket visits (part of school health program) Football club initiated PA activities (part of school health program)

PA *physical activity*, N *nutrition*

Analysis

Determinants were clustered into theoretically relevant composite variables. This clustering was performed by four researchers with a strong background in health promotion and implementation science, and clustering was debated until consensus was reached. After debate, eighteen composite variables were constructed (table 1).

Data was entered into IBM SPSS Statistics for Windows (version 20.0, IBM Corp, Armonk, New York) and scores on composite variables were calculated by dividing the sum of the individual item scores by the total number of items. Cronbach's alphas were calculated to test the reliability of the composite variables (table 5). Acceptable levels of internal consistency were reached in all cases (alpha's varied between .60 and .85) (56).

We initially planned to study IACO implementation in the same professionals over time. However because of 'research fatigue' and high staff turnover, the participants included during the first and second wave were unique in 94% of cases; only 8 participants filled out a questionnaire at both waves. We therefore decided to only include the second wave data of these 8 participants, and treated the participants of the first and second wave as independent samples. To account for possible experience-based differences influencing IACO implementation (57-59), we split participants into two categories: 0 to 12 months versus more than 12 months of IACO implementation experience. Next to the composite variables, experience with IACO implementation was then added as a dichotomous variable to the analysis. Finally, 'the number of prescribed activities' was included as a predictor variable as we theorized that this number could be interrelated with implementation success. For example, if only a low number of relatively simple activities needed to be executed we expected that a high degree of adherence would be easier to reach. No survey mode effect (online versus via paper) was found ($F(1,113) = 1.86$, $p = .176$).

No missing values were found for the outcome variable adherence, whereas the 4.4% missing's appeared random across the 19 determinants ($\chi^2(412, N = 115) = 430.95$, $p = .250$). Missings ranged from zero (the variable 'information acquisition') to 15.7% (the variable 'collaboration community'). We used the Markov Chain Monte Carlo (MCMC) method for MI provided in SPSS to impute missing values. This procedure provides pseudorandom draws from multidimensional probability distributions using chains of random variables distributed based on the characteristics of the previous variable (Markov chains) and is widely used to impute data missing at random (60). All variables were included in the imputation model. In accordance with Graham, Olchowski & Gilreath (61), we ran 20 imputations with 10 iterations. All imputed datasets were pooled according to the rules as suggested by Rubin (62). The MI results are displayed in the results section.

Descriptives were calculated for all variables. We used two one-way ANOVAs to verify if adherence differed significantly across communities and sectors. These analyses revealed that only the mean degree of adherence of professionals embedded in the educational sector significantly differed from professionals embedded in the healthcare, welfare, sports and private sector (p=<0.05). Also, the mean degree of adherence of professionals working in communities A & B significantly differed from the professionals working in the other communities (p=<0.05). Hence, in addition to the aforementioned predictor variables, a 'no/ yes education sector membership' variable and an 'IACO community' variable (community A/community B/ Other communities) were included in the univariate linear regression. All variables that appeared significantly related to the outcome variable in the univariate analysis were included in a multivariate regression analysis. The first block consisted of the determinants most proximal to the professional implementing the IACO (characteristics of the user), the second block contained the more distal determinants (characteristics of organisation, innovation strategies and context) and the third block consisted of background characteristics (e.g. time of experience with the IACO, sector and community). Within blocks, the enter-method was used to enter constructs into the analysis.

Results

Sample achieved

A total of 256 professionals were invited to participate; 176 (response rate 45%) during the first wave and 80 (response rate 79%) during the second wave. Of the 256 participants, 62% were embedded in the educational sector, 13% in the welfare sector and 25% in the other three sectors. Moreover, 53% of participants implemented an IACO activity in community A, 25% in community B, 9% in both community C and D, and 4% in community E. The difference in the number of participants between sectors, communities, and waves reflects the size and ever changing character of the IACOs included (figure 1, table 4). For example the difference between waves in specific communities; IACO implementation was not fully underway in communities C, D and E during the first wave, and IACO implementation halted in some organizations in communities A & B before the start of the second wave. Hence, more IACO activities were being implemented in communities A & B during the first wave, and thus more professionals from these communities met the inclusion criteria and were invited to the participate. The differences in participants across sectors was related to the distribution of IACO activities across sectors; the educational- and welfare sector were most prominently involved in the implementation of IACO activities.

Nineteen questionnaires showed more than 25% of missing values, and were deleted from the sample. A final total of 115 questionnaires were found eligible for analysis (figure I).

Participant characteristics

Of the 115 participating professionals, 90 (78%) were female and 61 (53%) were situated in community A. The mean age was 38 years (SD: 11.9) and the mean working experience of professionals was 133 months (SD: 111.5). Most professionals were embedded in the educational sector (62%), followed by the welfare sector (13%). With regard to time of experience with the innovation, 65 (57%) of the participating professionals implemented the IACO activity for 12 months or less, whereas 50 professionals (44%) implemented the activity for more than 12 months (table 4).

Outcome and predictor variables

The mean degree of adherence to the prescribed IACO activities was 52% (SD= 29.4). Professionals embedded in the educational sector reported on average the lowest degree of adherence (M=41.5, SD=23) and professionals embedded in the private sector the highest degree of adherence (M=82.7, SD=19.3). Moreover, professionals from community C & E reported the highest levels of adherence (resp. M=89.6, SD=17.8 & M=89.7, SD=7.5), whereas professionals from community A reported the lowest levels of adherence (M=39.5, SD=25.3) (table 3).

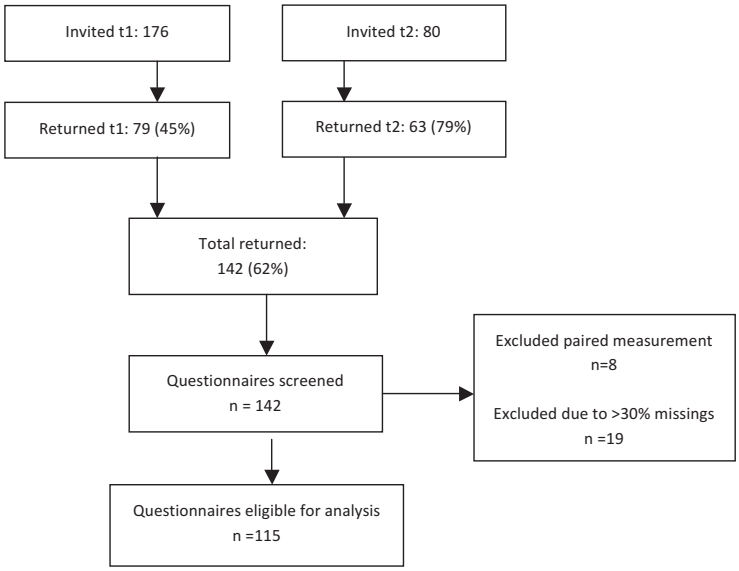

Figure 2. Participant flow chart

Across determinants, participants mean scores were highest on their self-efficacy towards IACO implementation (M= 3.9, SD= 0.6), their feeling of ownership towards the IACO objectives and their perceived match between IACO implementation and their task orientation (M= 3.8, SD= 0.7). Participants scored lowest on perceived risks in the environment for the implementation of outdoor play (M=2.9, SD= 1.0) and the extent to which their management had ratified IACO implementation (M= 3.0, SD= 0.9).

Univariate analysis

Univariate analysis revealed that a positive outcome expectation towards IACO implementation, the use of sound innovations strategies (i.e. training/ evaluation), more experience with IACO implementation, high perceived compatibility of IACO implementation with their task orientation, high feelings of ownership and high self-efficacy were most positively associated with the degree of adherence. Being embedded in communities A or the educational sector and being prescribed a higher number of activities was negatively associated with the degree of adherence.

Multivariate analysis

Predictors found significantly related to the degree of adherence in univariate analysis were included in a hierarchical multiple regression analysis (table 4). All assumptions for multiple regression were met (63). The final regression model was statistically significant ($F(12.32)=10.98$, $p=<.001$), and predicted two-thirds of the variance in the degree of adherence (adjusted $R^2=.65$). Positive regression weights were found for determinants self-efficacy ($\beta=0.32$; $p=<.001$; 95% CI (0.08, 0.55)),past experience with the innovation ($\beta=0.54$; $p=<.001$; 95% CI (0.38, 0.69)) and being an implementer embedded in Community B ($\beta=0.24$; $p=<0.05$; 95% CI (0.02, 0.46)). Hence, higher scores on these determinants appeared to be related to higher degree of adherence. A negative significant regression weight was found for formal ratification of implementation by management ($\beta=-0.18$; $p=<.05$; 95% CI (-0.33, -0.05)), and the number of prescribed activities ($\beta=-0.52$; $p=<.05$; 95% CI (-0.75, -0.28)).

Table 4. Participant characteristics

Characteristics	(SD)	Number (%)	Adherence (SD)
Gender			
Male		25 (22)	46.8 (29.4)
Female		90 (78)	69.3 (22.4)
Age. years	38.1 (11.9)		
Work experience. months	133.4 (111.6)		
Sector membership			
Education		72 (62)	41.5 (23.0)
Healthcare		12 (10)	77.8 (23.2)
Welfare & sports		24 (21)	60.2 (34.9)
Private		7 (6)	82.7 (19.3)
Community membership			
A		61 (53)	39.5 (25.3)
B		29 (25)	52.7 (27.9)
C		10 (9)	89.6 (17.8)
D		10 (9)	66.3 (16.9)
E		5 (4)	89.7 (7.5)
Experience with implementation of IACO			
0-12 months		65 (57)	38.7 (26.9)
>12 months		50 (43)	68.7 (23.5)

Table 5. Univariate en multivariate analysis

	α	(SD)	Univariate		Multivariate					
					Block 1		Block 2		Block 3	
			β	CI 95%	β	CI 95%	β	CI 95%	β	CI 95%
Personal benefits		3.64 (0.94)	0.44**	0.28, 0.61	0.03	-.177, .237	0.07	-0.14, 0.29	0.13	-0.04, 0.31
Outcome expectation		3.39 (0.96)	0.43**	0.26, 0.59	0.17	-.013, .354	0.14	-0.05, 0.33	0.03	-0.18, 0.12
Ownership & task orientation	.799	3.79 (0.73)	0.58**	0.43, 0.73	0.28*	0.04, 0.52	0.22	-0.04, 0.47	0.03	-0.18, 0.23
Social influence	.601	3.38 (0.65)	0.49**	0.33, 0.65	0.01	-0.28, 0.63	0.02	-0.20, 0.24	0.02	-016, 0.19
Self-efficacy		3.90 (0.64)	0.58**	0.43, 0.73	0.25	0.11, 1.32	0.30*	0.00, 0.59	0.32**	0.08, 0.55
Information acquisition	.864	3.69 (0.72)	0.45**	0.29, 0.62	0.004	-0.57, 0.47	-0.03	-0.29, 0.23	-0.02	-0.23, 0.19
Collaboration organization		3.61 (0.90)	0.47**	0.30, 0.63			0.10	-0.10, 0.31	0.02	-0.15, 0.19
Prerequisites implementation	.833	3.30 (0.75)	0.39**	0.23, 0.56			-0.07	-0.29, 0.15	0.02	-0.15, 0.18
Formal ratification		3.03 (0.91)	0.25**	0.07, 0.44			-0.18	-0.37, 0.01	-0.18*	-0.33, -0.02
Collaboration community		3.11 (0.77)	0.26**	0.07, 0.45			0.07	-0.14, 0.28	0.01	-0.15, 0.18
Innovation characteristics	.851	3.64 (0.53)	0.45**	0.28, 0.62			-0.16	-0.44, 0.13	-0.16	-0.38, 0.06
Innovation strategies	.850	3.13 (0.79)	0.54**	0.39, 0.70			0.28*	0.00, 0.56	0.14	-0.07, 0.35
Community A no/yes[a]			-0.44**	-0.61, -0.28					-0.14	-0.33, 0.05
Community B no/yes[a]			0.02**	-0.17, 0.20					0.24*	0.02, 0.46
Sector A no/yes			-0.45**	-0.61, -0.29					0.02	-0.17, 0.21
Experience implementation IACO			0.50**	0.35, 0.67					0.54**	0.38, 0.69
Number prescribed activities			-0.23*	-0.41, -0.05					-0.52**	-0.75, -0.28
Turbulence organization		3.12 (1.06)	0.11	-0.08, 0.30						
Support municipality		3.19 (0.76)	0.05	-0.15, 0.25						
Safety environment outdoor play		2.85 (1.02)	0.03	-0.18, 0.24						
Physical environment		3.29 (1.08)	-0.16	-0.36, 0.04						
Role of ethnicity		3.11 (0.94)	0.06	-0.13, 0.25						
Adjusted R^2					.34		.38		.65	
F for change in R^2					10.08**		6.45**		12.32**	

α Chronbach's alpha. *p=<0.05, **p=<.0.01, [a]the other communities combined served as a reference group in this model.

Advice for Practice & Research

- Longitudinal, mixed-methods research is needed to gain both a broad an in-depth understanding of IACO implementation and its determinants.
- Demand for a questionnaire that adequately measures determinants of IACO implementation is high. To answer this demand, we suggest future researchers to use, study and further refine the IACO-adapted MIDI.
- Results from this study indicates that IACO implementation can be optimized by increasing professionals' self-efficacy, for example via community stakeholder meetings.
- Sufficient time should be allowed for IACO implementation; we found that professionals implementation improves over time, and professionals need time to get acquainted and experienced with IACO implementation.

Discussion

The usage of IACOs to counter the issue of childhood obesity is rapidly expanding (54, 64), and knowledge on their implementation processes is necessary to optimize intervention effects (22). This study is one of the first to quantitatively evaluate the implementation of five EPODE-derived IACOs and the determinants of adherence to IACO-prescribed activities.

The degree of adherence varied across sectors and communities, and was on average 52%. Professionals from the educational sector and those working in community A and B reported the lowest degree of adherence. Univariate analyses showed that nearly all characteristics of the user, the organisation, the innovation, and the innovation strategy were significantly related to adherence. However, apart from a solid collaboration with community partners, the characteristics of the context were not associated with professional's adherence. In the multivariate analyses, five characteristics remained statistically most important; the degree of adherence increased with a higher perceptions of self-efficacy, past experience with IACO use, and being an IACO implementer in community B , whereas formal ratification of IACO implementation and a higher number of prescribed IACO activities were associated with a lower adherence degree.

Comparison previous literature

The model of Fleuren *et al.* (43) and the thereof derived IACO-adapted MIDI (47) proved to be a good fit to our data; the multivariate regression model accounted for 65% of variance in the degree of adherence. Furthermore, the moderate (52%) degree of adherence found in this study is in line with the degree of implementation reported in other studies, such as the process evaluation of Baltimore Health Eating Zones (65) and a multi-institutional

community-based program for diabetes prevention among First Nations (66). Several studies varying in quality and rigor have examined implementation determinants of intersectoral community approaches (33, 54). Little empirical knowledge (67) can be found in these studies to confirm our finding that self-efficacy is associated with professionals' implementation behaviour. However, several other public health innovation studies (50, 68, 69) and theories used in implementation research such as Bandura's self-efficacy theory (70) and the Theory of Planned Behaviour (TPB) (71) do corroborate the association found between self-efficacy and implementation success.

Professionals implementing an IACO in community B showed a significantly higher degree of adherence then professionals implementing an IACO in the other four communities. This difference could be due to the fairly successful toddler's gardening and healthy nutrition program that took place in preschools embedded in community B. This intervention was the 'showpiece' of this IACO; it was rolled out broadly and therefore a majority of the participants of community B implemented this intervention. Adherence levels of these implementers were significantly higher than the average level of adherence measured in this study (56%). The program had a strong base in public-private partnership, regular evaluation meetings took place and the program sites were frequently visited by an external implementation coordinator. All these factors have been reported in the literature to facilitate IACO implementation(72-77).

We found that determinants related to the context were not associated with the degree of adherence in the multivariate analysis. Other, mostly qualitative IACO implementation studies, have found that context related determinants such as collaboration among community stakeholders and participation of the target population affected implementation (64, 77-81).

The positive association found between time of experience and adherence builds upon Rogers' diffusion of innovations theory (23); a fairly high percentage of professionals adopts an innovation, less professionals implement an innovation and even less sustain their implementation. However, those that sustain implementation are most often better implementers. Also, the positive association is confirmed by the process evaluation study by Young *et al.* (72), but contradicts the review on prevention programs in schools by Dusenbury *et al.* (38). This contrast could be explained by differences in program design. The prevention programs in the school setting studied by Dusenbury were provided top-down and were highly protocoled (38), whereas IACOs often follow a combination of a top-down and bottom-up approaches and are less protocoled. A highly protocoled approach that leaves little room for local adaptations has been associated with discontinuation of the innovation (82), whereas the combined approach is cited to facilitate intervention

ownership (83, 84) and longevity (85). This might also explain the relatively lower, but not statistically significant in multivariate analysis, levels of adherence found among educational sector professionals; IACO activities prescribed to this sector were more protocoled in comparison with activities prescribed to professionals from other sectors. In our qualitative data, we also found that educational professionals frequently stated that strong competing educational demands and a related lack of compatibility of IACO implementation with their current work load impeded implementation (86). These determinants were not found to be significantly associated with degree of adherence in our multivariate analysis. We did however find that the related MIDI items 'matching goals' ($r=-.32$ $p<0.01$) and 'compatibility' ($r=-.25$ $p<0.01$) were only negatively correlated with educational sector membership, and not for other sectors. Hence, this could indicate that the lower degree of adherence found for educational professionals is mediated by a lack of compatibility of goals and current work load. Furthermore, we found that formal ratification of implementation by management was negatively associated with adherence in multivariate analysis, but positively associated with adherence in univariate analysis. Only the positive association has been found in previous studies evaluating IACO implementation (66, 74, 78, 87-90). We therefore explored the relation between formal ratification and other determinants further, and discovered that formal ratification was only negatively associated with adherence for professionals embedded in the educational sectors of communities A or B. It could therefore be that the significant regression weight found for 'formal ratification' is caused by a classic suppression effect (91) with the variable 'education sector membership'. Hence, the predictive value of formal ratification seems to increase and turn negative by the addition of the variable 'educational sector membership'. Whether formal ratification is indeed negatively associated with adherence, or if this is dependent on sector membership, needs to be clarified in future research.

Strengths & limitations

Selection of research participants was performed using purposeful sampling. This form of sampling is often used when evaluating complex approaches such as IACOs, but could have given rise to some degree of selection bias. For example, we gave priority for inclusion to those professionals that were implementing activities most crucial to reach IACO success. This may have caused us to select participants that were highly motivated and better implementers, as they agreed to carry out the most important (and often most time-consuming) activities. The inclusion of participants from multiple sectors implementing different IACOs can be counted among the strengths of this study. This, however, also provided us with several challenges. For instance, the number and scope of the prescribed IACO activities differed per participant. We argue that this diversity obtained is quintessential to and a true reflection of the practice of IACO implementation and that

our analysis should account for that. We also reasoned that verification of how this diversity might have obscured our conclusions was warranted. We therefore included both sector- and community membership and the number of IACO activities prescribed as variables in our analysis. Multivariate analysis then revealed that indeed the number of prescribed activities and community B membership were significantly related to adherence.

We do not have details about the reasons for the 35% non-response in this study, and can only speculate about how this might have obscured our conclusions. The descriptives we presented will be most sensitive to selection bias in case motivated professionals were more likely to respond. However, generalization with regard to the determinants of adherence may be less restricted since they are based in correlational analyses which are expected to be less vulnerable to possible selective attrition. On the other hand, because of the cross-sectional nature of the data, conclusions about the importance and sequence of the antecedents of IACO implementation are still tentative.

We used an IACO-adapted version of the MIDI to asses determinants of implementation. We aimed to optimize validity of the IACO-adapted MIDI by grounding any alterations made in the results of the qualitative data obtained in these communities, Validity was further enhanced by asking senior researchers to verify these alterations. Also, questionnaire style suggestions as proposed by Fleuren in the original MIDI were followed for all alterations. Although this MIDI is, in our opinion, the best option currently available to assess IACO implementation, some limitations of the questionnaire should also be mentioned. Implementation constructs were assessed via only one item, which could lead to a decrease in (predictive) validity (92). Due to time and resource limitations, the IACO-adapted MIDI was also not pretested. Pretesting could have potentially enhanced validity, and we therefore suggest other researchers to pre-test the alterations made to the IACO-adapted MIDI before using the tool again in practice.

Adherence was measured via a self-report which can be subjected to recall bias and/or bias induced by social desirability (93, 94). To prevent social desirability bias, we informed participants that we did not intent to verify their compliance with the protocol but merely wanted to gain insight into their experience with and opinions about IACO implementation. We also informed participants that all data would be anonymized. In spite of these actions, biases cannot be fully excluded. When calculating adherence, We furthermore did not discriminate between the non-execution and adaptation of IACO activities. Both were considered as non-adherence as it was not yet clear which IACO activities were most crucial for the interventions' impact. It is however argued that adaptation may improve the fit with local conditions (22), possibly leading to improved sustainability (82) and higher program effectiveness (33, 38, 95-97). More research is needed to verify to what extend adaptions

can be allowed without losing the intended impact. Due to time and resource limitations, we only measured adherence among professionals, while neglecting end-user-related aspects of implementation such as dosage received and reach which could mediate the health-related outcomes in children. We therefore in line with Saunders *et al.* (27) advocate future researchers to also asses this broader variety of process indicators, if resources are available. This study also provides leads for policy makers. By combing the results from IACO implementation research on the policy level with the results from this study, multi-level implementation strategies can be formulated to optimize the potential for implementation success. Hendriks *et al.* (98, 99) for example proposed, among others, training sessions to promote integrated health policy making. As we found that innovation strategies such as training are also important on the local implementation level, combined trainings on both levels could strengthening the connection between policy and practice and in turn, might enhance implementation efforts.

Conclusion

In conclusion, the results of our study suggest that IACO implementation can best be optimized by enhancing professionals' self-efficacy, limiting the number of prescribed activities and allowing sufficient time (more than 12 months) for the process of implementation of IACOs. If formal ratification of implementation by management is indeed associated with lower degrees of adherence, or if this is merely caused by a suppression effect needs to be further investigated. We would suggest researchers to further validate and refine the IACO-adapted MIDI, as no validated questionnaires to measure IACO implementation are yet available but demand for such a questionnaire is high. Finally, future studies preferably using a longitudinal design are needed to confirm the results of this study. This research could elucidate if differences in determinants occur over time and if determinants, in interaction or via mediation, influence implementation outcomes.

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Unravelling the factors decisive to the implementation of EPODE-derived community approaches targeting childhood obesity: A longitudinal, multiple case study.

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Abstract

Background. Implementation of intersectoral community approaches often fails due to a translational gap between the approach as intended and the approach as implemented in practice. Knowledge about the implementation determinants of such approaches is needed to facilitate future implementation processes.

Methods. The implementation of five EPODE-derived intersectoral community approaches was studied longitudinally. Semi-structured interviews were held with 189 community stakeholders from four sectors to elucidate which determinants influenced implementation, and if an to which extent determinants differed across communities, sectors and over time. A framework approach was used to analyze our data.

Results. Twenty-two key determinants of implementation were identified. Facilitators named were mostly proximal (stakeholder level), and barriers were mostly distal (context level). Key determinants varied greatly across sectors and over time, especially between the educational & health care sector and the private, welfare & sports sector. Only 'perceived importance of IACO goals' was identified as an universal implementation facilitator.

Conclusions. Striking differences in determinants were found across sectors and over time. Also, stakeholders expressed that possibilities to adapt the approach to the local context were needed to improve implementation. We therefore propose to develop sector- and time specific leads for implementation, which should be approved and amended (over time) by stakeholders. This so-called 'mutual adaptation' allows for the use of both scientific insights and practice-based knowledge, enabling program management and community stakeholders to collaboratively improve their implementation efforts.

Keywords: Children, Obesity prevention, Community approach, Implementation, Intersectoral collaboration, Process evaluation

Background

To address the pressing issue of childhood obesity (1, 2, 3), the French 'Ensemble Prevenons l'Obesité Des Enfants' (EPODE) program was developed (4, 5). The EPODE program is an Intersectoral community Approach towards Childhood Obesity (IACO). Its main objective is to address obesity determinants on the micro- (child), meso- (family) and macro level (community context), thereby accounting for the multi-factorial etiology of childhood obesity. EPODE also engages stakeholders from several sectors within the community to integrate its four major pillars; (1) social marketing, (2) establishment of public-private partnerships, (3) acquisition of political commitment and (4) guidance of the approach via a scientific evaluation (4). EPODEs program methodology is described in more detail elsewhere (4, 5). The EPODE approach appeared successful in reducing childhood obesity in two French pilot towns (6). After this success, the approach was scaled-up and various EPODE-derived approaches were launched worldwide (5). The Dutch developed the EPODE-derived JOGG approach (an acronym for Youth On a Health Weight, in Dutch), and as of yet 83 communities in the Netherlands have adopted this approach (7).

Although the implementation of the initial EPODE program led to promising results, similar IACOs have shown significantly less impact on health-related outcomes (8, 9). This lack of impact could be due to a translational gap often reported between the program as intended and the program as implemented in practice, especially in case of complex community-based programs (10, 11, 12, 13). Translation of programs into practice generally follow a four-stage diffusion process, often referred to as 'diffusion of innovations' (14). The first stage consists of 'dissemination'; actively promoting knowledge-awareness about a program among the target population. This stage is followed by 'adoption'; in which the stakeholder decides whether or not to accept and use the program. During 'implementation', the program is put into use. The final stage, 'continuation' concerns the extent to which initial program implementation is continued. This process of diffusion is dynamic and users go through stages iteratively. A user can for example halt program implementation, but later decide to re-adopt and restart implementation. This study focusses specifically on the stages of implementation and continuation. We will refer to these stages combined as 'the implementation process'.

To gain insight into the implementation process of IACOs, a pragmatic process evaluation is warranted. A process evaluation can help elucidate which determinants influence the implementation process (11, 13, 15, 16). As of yet, a variety of determinants affecting the process of implementation of health promotion programs in general have been identified (17, 18). For instance Fleuren *et al.* (19) constructed a framework that clusters 50

determinants of implementation of public health innovations. These determinants are split into four categories; the characteristics of the (1) adopting person (user), (2) innovation, (3) organization and (4) socio-political context.

Although some knowledge has been developed on the implementation of public health innovations in general, research on the implementation process of IACOs is still in its infancy. Only a limited number of studies have evaluated IACO implementation, and those that did have mostly focused on a single case, were performed at one moment over time, and assessed determinants of the implementation process in only one or two sectors (20).

To gain more insight into the process of IACO implementation, we studied the determinants of implementation of five EPODE-derived IACOs in the Netherlands. We evaluated whether and to which extent these determinants differed between communities, sectors and over time.

Methods

The design of our research was guided by the framework of Saunders et al. (21). This framework allows for an iterative adjustment of methods in accordance with local developments and the results of preliminary data analysis.

Setting

Five communities implementing EPODE-derived IACOs were included in this study. Following principles of purposeful sampling (22), inclusion of communities was based on opportunity, willingness to participate and creating on diversity in our sample. Three of the included communities were implementing an IACO based on the JOGG approach, whereas the two other communities implemented an EPODE-derived IACO not commissioned by the national JOGG project office. Moreover, the IACO implemented within community I targeted merely the promotion of healthy nutrition, whereas the IACOs implemented in communities II to V targeted both physical activity and nutrition. The extent to which the IACOs were protocolled also differed. The IACO implemented in community I was partly protocolled. Hence, instructions were provided on 'what' to do (EPODE pillars, Fig. 1) and also partly on 'how' to deliver activities. IACOs within communities II to IV were not protocolled; The program manager only informed stakeholders on 'what' goals needed to be accomplished, but not on 'how' to accomplish them. Stakeholders were instead asked to integrate the EPODE pillars in existing activities, or to establish new activities that served the EPODE goals. Furthermore, the target population differed across the included IACOs; I and III targeted children 0–12 years of age, whereas II, IV and V targeted children between 0

and 18 or 19 years of age. Finally, the degree of involvement per sector varied. For example more than five stakeholders from the educational sector were actively implementing IACO activities within communities I, IV and V, whereas only one stakeholder from the education field was actively implementing IACO activities in community III (Table 1).

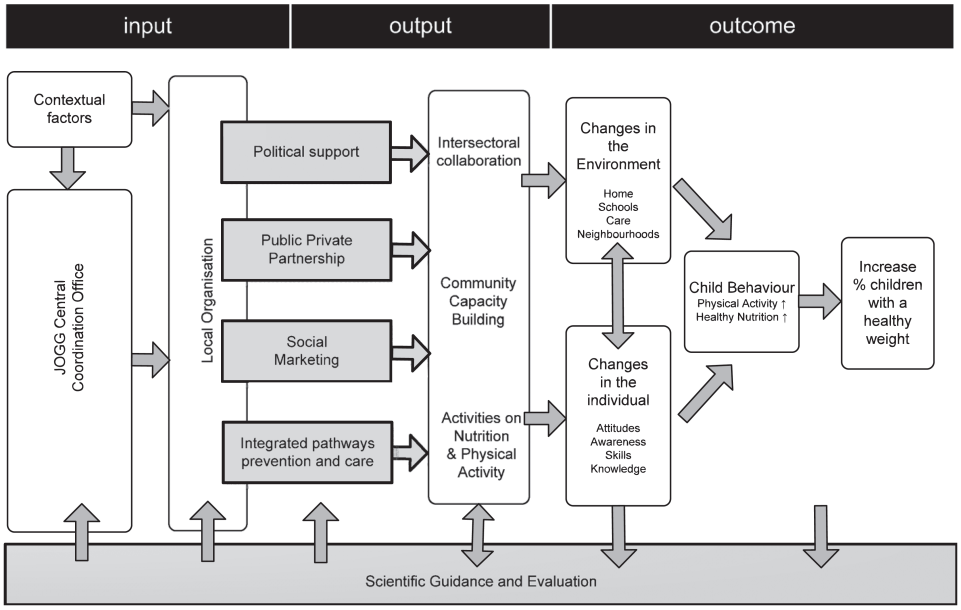

Figure 1. EPODE pillars & program methodology, van Koperen *et al*. (4)

Design

he implementation process of the included IACO's was prospectively studied during several 6-monthly research waves. Five research waves were held in community A, four in community B, three in community C, and two in communities D & E. The number of research waves varied because the starting point of implementation differed across communities, while all research activities needed to be completed within the time frame of the research project. As IACOs are dynamic and always in transition, stakeholders included during the first research waves were not always 'initial implementers' (having less than 12 months of experience), and those included third, fourth or fifth wave were not always 'continuing implementers' (having more than 12 months of IACO implementation experience). To counter this issue and facilitate analysis, we therefore asked every participant how much experience they had with the implementation of that particular activity, and divided them into those having

12 or less months of experience with implementing the IACO (initial implementation), versus those having more than 12 months of IACO implementation experience (continued implementation).

After inclusion the research started with a baseline assessment of the IACO. We formulated a 'state of affairs document' including a description of IACO objectives, a list of participating community stakeholders and a list of the planned IACO activities. This document served as input for tailoring research methods and instruments to the local context. After this assessment, research waves were performed every 6 months. Every wave consisted of semi-structured interviews with stakeholders. Interview were based on a topic-list derived from the framework of Fleuren et al. (19). At the start of each research wave, alterations or additions to this topic list were made based on the outcomes of the preceding wave. Verbal informed consent was obtained prior to the start of each interview and audio-recorded. We chose to obtain verbal consent instead of written consent as it is generally acceptable if no significant risks are involved for participants (23), and because it allowed for the (early) establishment of a bond of trust between researcher and participant. Moreover, it provided opportunity for participants to discuss any uncertainties or lack of clarity. All interviews were held face-to-face and were audio recorded, and duration varied from 15to 90 min, depending on the time available per stakeholder.

Sample

Stakeholders were invited to participate in our study if they implemented at least one IACO activity that met all of the following criteria:

1) The activity was part of the IACO (according to the project manager) or was financed by IACO management,
2) The activity took place within the community boundaries,
3) The activity comprised direct contact with the target population.

Due to limited resources and finances, not all stakeholders meeting the inclusion criteria could be invited. Priority for inclusion was therefore assigned to those stakeholders that implemented IACO activities expected to be most important to reach the intended health outcomes. For example reach of the activity, evidence available for the efficacy of the activity, and whether the IACO activity was recurrent were taken into account. Stakeholders were invited to participate either via telephone or email. Fourteen stakeholders declined participation. Reasons for non-participation were mostly related to a lack of time or research fatigue (24). A total of 189 stakeholders were included in our study: 89 (47 %) were embedded in the educational sector, 65 (34%) in the welfare & sports sector, 25 (13%) in the health care sector and 19 (10%) in the private sector.

Table 1. Characteristics included communities & IACOs

Community	I	II	III	IV	V
Type of IACO	JOGG	JOGG	JOGG	IACO based on EPODE	IACO based on EPODE
Implementation site	Neighborhood	Neighborhood	Neighborhood	Municipality	Municipality
Target population	0-12 years	0-19 years	0-12 years	0-18 years	0-18 years
Focus	N	PA & N	PA & N	PA & N	PA & N
Setup IACO	Partly protocolled	Not protocolled	Not protocolled	Not protocolled	Not protocolled
# inhabitants implementation site	27.400	13.325	7.345	18.216	40.958
Interventions that were included in our study per sector					
Educational	Fruit & water campaign	Preschool gardening & healthy N program	Integrated, multidisciplinary program elementary schools *(Nicely Fit!)*	Integrated, multidisciplinary program elementary schools *(Score for Health)* (pre)school PA & N policies	Integrated, multidisciplinary program elementary schools *(Score for Health)*
Health Care	Fruit & water campaign	Healthy N resilience program	Children's physical therapy 'toddler gym'	Children's physical therapy 'toddler gym'	-
Welfare & sports	Fruit & water campaign	Municipal PA & N 'stimulation & connecting' program	Integrated 'active communities' PA program Free running	Afterschool PA intervention N activities	Walk & run together community PA program 'Try a sport you like' community PA program
Private	Fruit & water campaign	Sponsoring of PA & N activities	Weight watchers class teen moms 'Soup-making' healthy N activity Sponsoring of PA & N activities (e.g. funding school playground)	School supermarket visits Football club initiated PA activities	School supermarket visits Football club initiated PA activities

PA *physical activity*, N *nutrition*.

This sample mirrored the involvement of the different sectors within the IACOs at that time. In our sample, 82 (43%) stakeholders were implementing an IACO within community I, 27 (14.3%) in community II, 34 (18%) in community III, 28 (15%) in community IV and 18 (10%) in community V.

Analysis

A four-stage Framework Approach (FA) (25) was used to guide our qualitative analysis (Fig. 2).

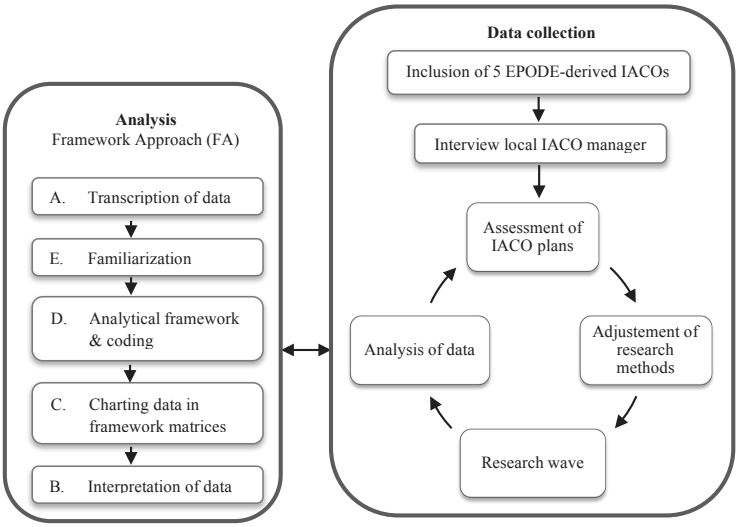

Figure 2. Research design

Stage A: transcription

All audio-taped interviews were anonymized and transcribed verbatim. Anonymity of the participant was ensured by replacing the name of the participant with a number, and by not transcribing the names of other persons that were mentioned during the interview.

Stage B: familiarization

All interviews were read in full text by two researchers (RK, SA) independently. Notes were made in the interview margin if any important segments were identified.

Stage C: development of an analytical framework & coding

Atlas.ti for Windows version 6.2 (Scientific Software development, Berlin) was used to analyze our data. Coding was performed by two researchers and was primarily deductive; the framework by Fleuren et al. (19) was used to develop a code tree. Determinants emerging from our data that fell outside of the coding tree were added to the tree inductively. A document containing an operationalization of all codes was created and sequentially updated if new codes emerged.

The process of analysis commenced with the coding of one transcript by the two researchers jointly, to ensure both researchers interpreted and used codes in an uniform manner. The further process of coding was performed by the two researchers separately. Any discrepancies in coding were debated in person until consensus was reached.

Stage D: charting the data into a framework matrix

Within- and cross-case displays as proposed by Miles & Huberman (26) were used to chart our data. A within-case display was formulated per interview (participant), and consisted of a short narrative followed by a description of the key barriers and facilitators. A determinant was considered a key barrier or facilitator if it became evident from the interview context that the stakeholder felt more strongly about a certain barrier or facilitator then other determinants. If for example a stakeholder stated that 'lack of time was (one of) the most important thing that held me back from carrying out activity x', time was considered a key barrier. Derived from the individual within-case displays, cross-case displays per community, sector (sector categorization, additional information 1) and time period (initial and continued implementation) were established.

Stage E: interpretation of the data

Cross-case displays were studied to (a) identify the most frequently named key barriers and facilitators per community and sector across time periods.

Results

Twenty-two unique key determinants of IACO implementation were identified across communities, sectors and time periods. Thirteen key determinants were related to characteristics of the innovation and user, whereas nine determinants were related to the innovations strategy, organization and community & context. Facilitators were mostly user-related, barriers were for the greater part related to innovation (strategies), organization and context. An overview of all key determinants, their operationalization and illustrative

quotes is provided in Table 2. Key determinants identified per time period and sector are also displayed in Table 2. Figure 3 illustrates similarities and differences in key determinants per sector and over time.

Similarities in determinants across sectors, communities and in time

High perceived importance of IACO goals was identified as a key facilitator across all communities, sectors and in time.

> No, it (the IACO) is really a passion of mine, a personal motive, we just want to make the world a better place. Not on a large scale, just starting small. To help them (children) feel 'I am worth it, and I have a good quality of life'. (Youth welfare worker, community I. *(Youth welfare worker, community I)*

A high level of self-efficacy for IACO implementation was also identified as a key facilitator in all communities and over time periods, but not for the private sector.

> You have to make a detour for it (the implementation) to work. You have to water your garden, attend to the plants and keep an eye on the children. So, it demands more of you, but it is worth it! (*Preschool teacher, community II*)

The following barriers were named to impede implementation in all five communities, but not in all sectors and time periods: Incompleteness of innovation materials (such as sports equipment or gadgets such as water cans or stickers), low procedural clarity, lack of time and/or resources, organizational turbulence, minimal participation of the target population and lack of feeling a shared commitment with partners for IACO implementation.

Sector-specific determinants

Educational sector

A lack of time and resources was only named as a barrier for implementation by educational stakeholders. The barrier was named in all communities, during both initial and continued implementation.

> Lately, management has been tinkering with our working hours, We have to undertake all sorts of activities we absolutely don't have time for. And this (the IACO) is then typically something that doesn't get done. If we would just get two hours or so to prepare for it, but that's just not going to happen. If we would get extra hours, then I think implementation of the IACO would be compatible with our regular program. (*Teacher, community V*)

Table 2. Overview of key determinants per sector, community and in time

Direction	Category	Determinant	Operationalization	Comm	Initial implementation[1]			Continued implementation[1]				
					Edu	HC	WS	Priv	Edu	HC	WS	Priv
					n=43	n=9	n=33	n=8	n=37	n=14	n=32	n=11
Facilitator	User	Importance	Feeling that IACO goals are of importance	I-V	61	55	79	100	70	86	53	73
	User	Self-efficacy	Beliefs about the ability to reach IACO goals	I-V	47	33	36		41	36	40	
	Innovation	Uptake into routine	Possibility to integrate IACO activities into daily working routine	I, II, V			30		38	21		
	Innovation	Possibilities to adapt	*Possibility to adapt non-essential elements of IACO*	I-IV	54						22	
	User	Moral obligation	Having considerations, stemming from personal values, about whether it is 'right' or 'wrong' to implement the IACO	I-III				68				
	User	Goal compatibility	*Compatibility of IACO goals with organizational or user goals*	I-V								46
	Community	External collaboration	*Collaboration community stakeholders with respect to IACO*	I-V				38				
	Innovation	Compatibility	Level to which IACO activities are compatible with pre-existing practices	I-IV		44						18
Barrier	Innovation	Completeness	Completeness of IACO activities (e.g. parent meeting) and materials (i.e. manuals, gadgets)	I-IV	35	44		50			22	
	Community	Shared commitment	*Feeling of shared commitment with community partners for IACO implementation*	I-V				38				46
	Innovation	Procedural clarity	Level in which IACO procedures are clear	I-V			30					46
	Community	(Anticipated) response target population	Level of participation of children and parents in IACO activities	I-V						28		36
	User	Time/resources	Availability of time/resources to implement IACO	I-V	28				27			
	Community	External collaboration	*Collaboration community stakeholders with respect to IACO*	I-V			27				25	
	Organization	Financial resources	Availability financial resources organization to implement IACO	II-V			27				22	

Table 2. Overview of key determinants per sector, community and in time

Direction	Category	Determinant	Operationalization	Comm	Initial implementation[1]			Continued implementation[1]				
					Edu	HC	WS	Priv	Edu	HC	WS	Priv
					n=43	n=9	n=33	n=8	n=37	n=14	n=32	n=11
	Community	Observability implementation	*Observability of IACO implementation by other community stakeholders*	III				68				
	Innovation	Management innovation	Management / organization of innovation	I, III, V						43		
	Innovation strategies	Reinforcement strategies	Reinforcement strategies to promote ongoing IACO use (e.g. a training or new promotional materials)	I-V					36			
	Organization	Organizational turbulence	Changes in organization affecting IACO implementation (e.g. reorganization, cuts)	I-V		33						
	Innovation	Compatibility	Level to which IACO activities are compatible with pre-existing practices	I-V		33						
	Innovation	Instrumentality	Quality and durability of materials	I, IV	30							
	User	Implementation priority	Priority assigned to implementation of IACO	I-IV					30			
	Community	Limiting factors target population	*Level to which limiting factors (i.e. behavioural, financial problems) are present in target population*	I,III,V						29		

[1]Percentage of stakeholders naming the key determinant is displayed. Comm *Communities*, Edu *Educational sector*, HC *Health Care sector*, WS *Welfare & Sports sector*, Priv *Private sector*

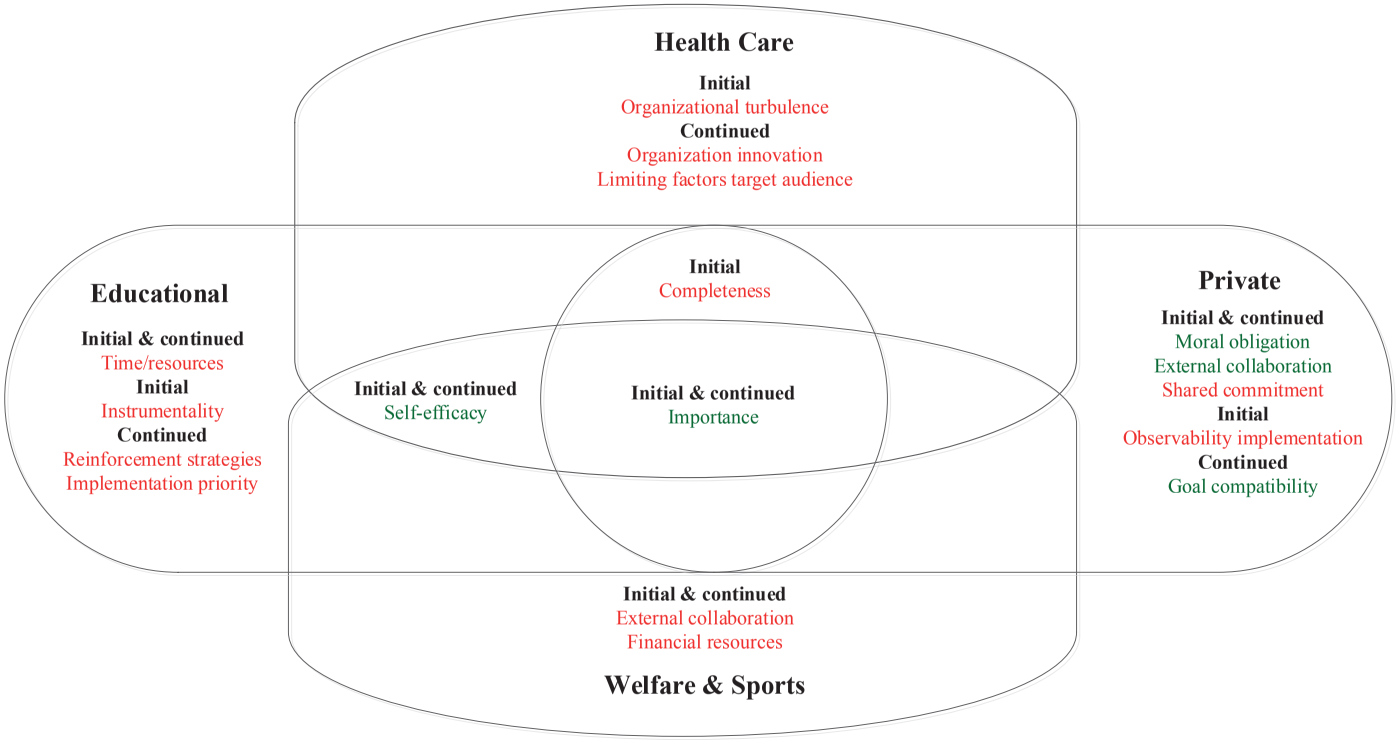

Figure 3. Visual display of unique and universal determinants across sectors

Educational sector stakeholders explained that they were primarily held accountable for the academic performance of their students, and not the prevention of health-related risks.

> We have been so busy the last couple of years, at a certain moment you think 'I don't even know the name of this student in my class. So I think.. Yes, our main priorities lie elsewhere, not with this water campaign. (*Teacher, community I*)

Low quality and durability of the IACO materials (instrumentality) was only mentioned to impede implementation by educational stakeholders. Also, solely educational stakeholders expressed during continued implementation that a low priority assigned to IACO implementation (communities I–IV) and a lack of reinforcement strategies (all communities) were key barriers. Educational stakeholders mentioned they needed a continuous reinforcement of IACO implementation because of the low priority they assigned to implementation and their perceived lack of resources.

> The project has been put on the back burner. We need someone who will say to us: Do you still focus on the implementation of the project? (*Teacher, community I*)

A facilitator for educational stakeholders during initial implementation was the possibility to adapt non-essential elements of the intervention.

> One of my colleagues has bought an extra elastic band, a large band. This band prevents that the cover of our school garden gets blown away by the wind; the provided tie-wraps just didn't work for us. (*Preschool teacher, community II*).

Health care sector

Health care stakeholders mentioned that 'organizational turbulence' caused by the recent merge of the majority of their local youth health care facilities, impeded the implementation process of the IACO.

> But you know, because of the relocation, everything (campaign materials) has been stored into cabinets. And nobody has really finished unpacking. So, it is just a bit like: I accidently found another campaign bag, let's give that to the next patient. (*Youth health nurse, community I*)

Perceived behavioral or financial problems of the target population were identified as key barriers for implementation by the stakeholders in health care, in communities I, III and IV.

> It's the general attitude of parents, they are difficult to reach. Some parents just don't want to change. They don't go to any health care provider. They just think: it (obesity) will pass. That does not facilitate my implementation of the intervention. (*Children's physical therapist, community IV*)

Formal uptake of IACO activities into their daily working routine was also solely mentioned as an implementation facilitator by health care stakeholders, in three out of five communities.

Welfare & sports sector

Unsound collaboration, for instance a perceived lack of response from other stakeholders when collaboration was initiated, was identified as a key barrier to initial implementation only for stakeholders embedded in the welfare and sport sector. Inadequate financial resources was also only identified as a key barrier to these stakeholders.

> We just perform our own activities, and that's it. I do think we could make a lot of progress (with IACO implementation) if we would work together as community partners. I really believe that would make a difference! (*Youth welfare worker, community III*)

Stakeholders from this sector also stated that implementation was sometimes hindered by a lack of procedural clarity, for example caused by insufficient information being available on when and how certain IACO activities needed to be performed.

> What is exactly the goal of JOGG, what do they want to achieve? And in which manner? This remains totally unclear to me. (*Welfare worker, community II*)

Private sector

Exclusively for private sector stakeholders, solid collaboration with community stakeholders was named to facilitate implementation. Solid collaboration to them meant for instance 'smooth communication between stakeholders on the division of tasks' and 'the reciprocal sharing of resources or facilities with other stakeholders'. Feeling morally obliged to implement the IACO was also identified as a key facilitator, during both continued and initial implementation.

> I own a commercial enterprise, but I also find it important that children are healthy. Therefore, I will provide the (health promotion) training to teenage mothers almost for free. It is just necessary to be a socially responsible entrepreneur. (*Owner private enterprise, community III*)

Only within this sector, continued implementation was facilitated by a high compatibility of stakeholders' and IACO goals. Stakeholders for example stated that by providing fruit free of charge (IACO goal), they expected to make more profit as parents would be enticed to buy other products in their store (own goal). Finally, invisibility of the IACO implementation of other stakeholders and feeling no shared commitment for IACO implementation with these stakeholders were identified as private-sector specific key barriers.

> I think that is of importance to, well to get a clear story. To gather all community partners every couple of months and discuss 'what are we going to do?' or 'what vision do we want to project? Because at the moment, I have no clue about what happens in the schools or at the Centre for Youth & Family. (*Supermarket manager, community I*)

Discussion

This study aimed to elucidate which determinants are decisive for IACO implementation, and if differences across communities, sectors and over time were present.

Twenty-two key determinants of IACO implementation were identified; 13 barriers, seven facilitators and two were identified as both a facilitator and barrier. Facilitators were mostly internal (stakeholder level), whereas barriers were mostly external (innovation context). Key determinants varied to a great extent across sectors and over time. Striking differences in sector specific determinants were found; Determinants named by stakeholders embedded in the private and welfare & sports sector were most often related to the context and organization level, whereas educational and health-sector stakeholders attributed barriers more often to the intrinsic characteristics of the innovation. Only one determinant, perceived importance of attaining the IACO's goals, was identified as a facilitator across all sectors, communities and time periods.

Interpretation of findings

This study showed that IACO implementation determinants were in large part sector and time specific. This is a new finding, as previous studies have mostly focused on IACO implementation in general and not on implementation within specific sectors and over time (20). Specifically for the private, welfare- and sports sector, determinants related to the 'community and context' were found to influence IACO implementation. For instance, (un) sound collaboration with community partners was only named by these stakeholders as a key determinant, and not by educational- and health care stakeholders. This could reflect the nature of the IACO activities prescribed; for example the football club embedded in community III needed to collaborate intensively with the local welfare organization to recruit

participants and to ensure the use of certain facilities. In contrast, education and health care stakeholders were prescribed IACO activities that required little collaboration and that could mostly be performed within their own setting. This indicates that collaboration is only perceived as a determinant to IACO implementation if participating stakeholders are dependent on other stakeholders for the set-up of their activities, resources, or the recruitment of participants. This is important to conclude, as IACO implementation is then partly dependent on the willingness of another stakeholder to collaborate or assist with the other stakeholders' IACO implementation.

Private sector stakeholders stated that collaboration with community partners was a key facilitator to implementation, whereas welfare- and sports stakeholders perceived this as a key barrier. This difference could be based in the welfare- and sport stakeholders' perception that the large effort needed to establish collaboration did not balance the anticipated target group benefits of implementation ('outcome expectations (19)'). In contrast, private sector stakeholders viewed collaboration as a 'significant effort' but stated that this effort was balanced by the expected external (material) rewards (perceived external instrumentality (27, 28)). These external rewards emanating from collaboration were for example the extension of their clientele, and opportunity to meet new business partners. Moreover, solely private sector stakeholders named that a limited shared commitment with community stakeholders for and low visibility of their IACO implementation decreased their implementation efforts. Both of these determinants can be viewed as requirements to reach their perceived internal and external rewards linked to collaboration. For instance stakeholders might have expected that a lack of shared commitment would decrease their opportunities to extent their business network, and that a low visibility of implementation would reduce the opportunity to communicate 'a positive company image' to potential clients. Also, only private sector stakeholders mentioned that IACO implementation was facilitated because they felt morally obligated to implement the IACO. Subsequent feelings of being a 'socially responsible' entrepreneur could be considered as an internal reward. Striving to be a socially responsible entrepreneur and strengthening connections with potential business partners have also been named as most important motivators for private stakeholders' IACO implementation by Leenaars *et al.* (29). However, if and how perceived internal and external instrumentality generated by these determinants is the source of implementation motivation needs to be further explored.

Only for welfare- and sports stakeholders, a 'lack of financial resources' was identified as a key barrier to IACO implementation. Although the absence of financial resources is a widely cited barrier to implementation of IACOs (30, 31, 32, 33, 34, 35), it has not previously been identified in specific for this sector. We argue that the availability of finances could be a key barrier especially for the this sector, as they, of all sectors, are most dependent on external

(government-based) subsidies. When our study was conducted, the Netherlands was in the middle of a financial recession (36). This recession gave rise to a significant decline in governmental and municipal financial support and subsidies, especially those that were not considered to facilitate basic needs (such as health care and education). This might explain why 'a lack of finances' was such a prominent barrier to implementation for welfare stakeholders. However, it should be noted that all organizations that rely on government based-subsidies, and not only welfare- and sports organizations, could be at risk for IACO implementation failure if subsidies are cut or withdrawn.

Attributes of the target population, for example the presence of financial or motivational problems, were only named as barriers by health care stakeholders. Other studies also reported on the influence of target population attributes on IACO implementation (34, 35, 37), but not with reference to a specific sector. Lack of motivation and compliance of patients is however frequently reported as an impeding factor for the integration of preventative activities in the daily practice of health care professionals (38, 39, 40, 41). Moreover, studies have shown that primary care providers often feel ill-equipped to improve the motivation of children and parents and are concerned that raising the issue might damage the patient-provider relationship (42). Countering these attitudes and beliefs and thereby improving the self-efficacy of health care stakeholders has been demonstrated to facilitate implementation of childhood obesity counseling in primary care (43).

Educational stakeholders stated they had insufficient time and resources available to implement IACO activities, as they committed the limited time and resources available to ensure their students' academic performance. Other studies also reported that demands teachers face with regards to students' academic achievements can conflict with priority for health promotion in the school (44, 45, 46, 47, 48). This priority dilemma also links to what is referred to as contextual integration in the Normalization Process Theory (49), meaning that the implementation and normalization of activities depends on how it relates to (the demands and context of) the organization it is implemented. Hence, although teachers might consider childhood obesity prevention as important, IACO-activities do not seem to agree with their primary task. Arguably related to the lack of priority, solely educational stakeholders expressed the need for continuous external reinforcement to sustain IACO-activities. This finding are in line with the results of a recent study from van Naussau *et al.* (48) on the implementation of the school-based obesity prevention approach DOiT. They found that the continued implementation of an obesity prevention approach in schools is influenced by opportunities to re-use intervention materials and incentives on how to continue implementation. Installment of an internal implementation coordinator who can

manage and apply reinforcement strategies might be a solution to this problem (48). This coordinator could then also function as the 'first point of call' for teachers who are in need of tips and tricks on how to implement activities when only limited time is available.

Across sectors, we found that IACO implementation was facilitated if a stakeholder perceives IACOs' goals as important. This finding is corroborated by other studies examining IACO implementation (32, 34, 50, 51, 52). However, less successful implementers also stated they felt the goals of the IACO were important. This might suggest that perceiving IACO goals as important is not a decisive factor to implementation, but that only in combination with other facilitators (or the absence of other barriers) implementation success can be achieved. High self-efficacy was also identified as a key facilitator to IACO implementation; across time and in three out of four sectors. Few previous studies have found this determinant to be of importance, only Davis *et al.* (53) mentioned self-efficacy influenced the implementation of the IACO 'Head Start'. Self-efficacy is however empirically tested as a highly relevant determinant in many other innovation studies, outside the context of IACO's, as it is accounted for by several implementation frameworks (such as the Fleuren framework (19) used in this study) and theories of behavior change (54, 55).

Strengths & weaknesses

This study is the first to systematically (21) evaluate determinants of IACO implementation in multiple communities, sectors and over time. Moreover, in concordance with the latest insight on how to best prevent childhood obesity (16), this study gives a voice to a large sample of community stakeholders on what is important and feasible to them when it comes to IACO implementation. Another strength of this study is the iterative adjustment of research methods, in line with local community developments. This allowed us to fine-tune our data collection, and to gain a more internally consistent evaluation of IACO implementation determinants. Several strategies were adopted to generate optimal reliability and internal validity of our data (26, 56). All interviews were recorded and transcribed verbatim, and data analysis was performed by two researchers via a framework approach (25) using analytical software. Data was reduced in multiple steps through the formulation of narratives and within- and cross case comparisons (26). Selection of participants in this study can be considered both as a strength and limitation. We included five communities in this study, which differed in size, childhood obesity rates and other characteristics. From these communities, a relatively large sample of stakeholders from diverse sectors was included. We therefore argue that we obtained the most diverse and representative sample possible considering local resources and opportunities, but do feel that this purposeful sampling might have given rise to selection bias. For example stakeholders that declined participation often indicated they were experiencing research fatigue (24) or time limitations. One could then hypothesize that stakeholders who did agree to participate were more motivated or

les strained by their workload. Also, because the community setting is dynamic, we were not able to follow the same participants over time. We for example encountered a high staff turnover in several organizations or a rapid change in policy causing a halt in IACO implementation. To counter these challenges, we compared stakeholders based on the time they were implementing the IACO and made a cross-sectional comparison of data.

Finally, we used a semi-action research design; we provided an overview of study results to community stakeholders following every research wave, without advocating if and what changes should be made to IACO implementation plans. This approach was chosen to empower community members as much as possible, whilst keeping data contamination minimal. Solely presenting the results to the stakeholders initiated some changes in implementation plans, but not all results could be translated into practice because stakeholders lacked the time and (human) resources to do so. We feel that, although this might lead to more data contamination, full Participatory Action Research (PAR) (57) would be a superior approach to use in future IACO implementation studies. Research and practice work together in PAR to translate research findings into implementation plans, enabling a swift transition of research finding into practice.

Conclusions

The implementation of IACOs is both dynamic and complex. Different determinants influence IACO implementation over time and across communities and sectors. We therefore argue that a tailored implementation plan should be formulated per sector and in time, preferably using a 'mutual adoption strategy (58). Mutual adaption enables IACO program managers and community stakeholders to collaboratively improve implementation efforts, by combining both the latest scientific evidence and best practices. Moreover, stakeholders are asked to verify implementation plans during multiple points over time, ensuring an optimal fit with local needs and circumstances. This strategy has been reported to enhance the implementation of complex health promotion approaches in several other studies (59, 60). Finally, we advise future research to use mixed methods and a participatory action research design to evaluate the use of tailored IACO implementation plans and to elucidate which implementation strategies best match these plans.

Abbreviations

EPODE: Ensemble prevenons l'Obesité des enfants
IACO: Intersectoral community approach to childhood obesity
FA: Framework approach

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Availability of data and supporting materials

Data generated during this study will not be made publicly available, as details mentioned during the interviews could possibly be traced back to (a group of) individual professionals. However, data is available from the corresponding author on reasonable request.

Authors' contributions

RvK, MC, TP and RR conceived and designed the study. RvK performed the data collection, data entry and analysis. TP, MC and RR supervised this research process. The manuscript was written by RvK; TP, MC and RR drafted and revised the manuscript. All authors approved the final manuscript.

Competing interest

The authors declare that they have no competing interests.

Ethical approval and consent to participate

This study was approved by the ethical committee of the Faculty of Psychology of the University of Leiden, reference number 8259652117.

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Does network development relate to implementation success of intersectoral community approaches targeting childhood obesity? An exploratory social network analysis.

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7

Submitted

Abstract

Background. The childhood obesity epidemic remains a major threat to public health. Intersectoral community approaches, in which the entire community of the child is mobilized to create a non-obesogenic environment, have shown promising results. It has however proven difficult to replicate these favourable results. This might be related to the fact that implementation of these interventions into practice is troublesome. It has been argued that intersectoral collaboration and community partnership are related to implementation success of these approaches, but whether they are and how is not well understood.

Methods. We evaluated the development of community partnership networks and implementation success within three EPODE-derived approaches in the Netherlands. A Social Network Analysis questionnaire was used to measure network parameters. Implementation success at the network level was determined via the 'JOGG progress tool'. Network data was analysed via UCINET, and the relation between network parameters and implementation success was evaluated descriptively.

Results. Implementation degree varied across communities, and was highest for the domain 'local organization' and lowest for the domain 'linkage between preventative and curative care'. Network size was largest and most constant in community A, whereas network size was lower in communities B&C but increased over time. Across communities, project management was identified as the most influential and prominent actor. We furthermore found indication for a positive association between a balanced distribution of actors per sector and the degree of IACO implementation, whereas a higher level of collaboration, a larger network size, a less centralized network and a decrease in centralization over time appeared associated with lower implementation degree. No indication was found for an association between the centrality of project management and implementation degree. We did find indication that the change in network parameters over time might be more strongly associated with implementation degree than the assessment of these parameters at one single point in time.

Conclusion. This study offers a novel insight on how IACO community partnership networks develop over time, and that network parameters are partly related to implementation success. Its results provide leads for the formulation of network development strategies that could potentially optimize IACO implementation. Future studies should further explore these leads and possible strategies in vivo, as to refine EPODE program methodology and ultimately improve IACO implementation.

Introduction

Childhood obesity

Childhood obesity is considered one of the major public health crisis of the twenty-first century (1, 2); Being obese as a child can lead to (severe) adverse effects on health during both childhood and adulthood (3-7). Despite numerous attempts to reduce and prevent childhood obesity, its prevalence remains high (1, 8, 9). Research has indicated that to lower the staggering prevalence rates of childhood obesity, a 'system approach' addressing the multifactorial aetiology of childhood obesity is needed (10, 11).

Intersectoral community approaches to address childhood obesity

To adequately address childhood obesity, not only the child needs to be targeted but also the complex systems embedding the child and its development. An example of such an approach is an Intersectoral community Approach to Childhood Obesity (IACO). One of the most successful IACOs to date has been the French 'Ensemble Prévenons l'Obésité De Enfants' (EPODE) approach. The EPODE methodology is described in more detail elsewhere (12-14). In short, EPODE engages stakeholders from multiple sectors to create a non-obesogenic environment by building on its four pillars: (a) political and organizational commitment, (b) collaboration between public and private organizations, (c) use of social marketing and (d) the support of scientific evaluation. In its two pilot communities, a fifty percent decline in the proportion of childhood obesity was achieved after ten years (15). This success led to the development of a dozen EPODE-derived interventions in several countries (12, 16), such as the Dutch JOGG approach (acronym for Youth At a Healthy Weight, in Dutch) (12). However, translating these IACOs into practice proves to be difficult; practioners often voice significant barriers to its implementation process (17). Failed translation of an IACO into practice can potentially cause a decline in the degree to which the target population is exposed to essential program elements, which in turn may lead to a decline or even loss of IACO intervention effect. It is therefore important to evaluate not only intervention effect, but also the IACO implementation process (18). Such an evaluation can help to detect translation failure in time, and it provides an opportunity to identify which IACO program elements are most effective, and what determines implementation success and failure (19).

IACO implementation and the importance of intersectoral network development

EPODE (and thus the Dutch equivalent, JOGG) argues that if an IACO is implemented by a variety of local stakeholders who are working together to reach intervention goals, the impact on childhood obesity will be greater than if individual stakeholders will try to reach these goals on their own (13). EPODE also expects that the level of collaboration and

network developments is related to implementation success (20). Several of the Dutch JOGG approach objectives therefore address the establishment and continuation of community partnership networks (box 1, column A).

The relationship between partnership networks and IACO implementation

The number of studies addressing the development of a stakeholder partnership network within intersectoral community approaches is still small (21-30). Most of the (social) network research in health promotion has focussed on transmission of diseases (31) and the influence of social support and capital on health outcomes (32-34). The few studies that did investigate the relation between partnership networks and IACO implementation showed that implementation of an IACO can increase the size of the local stakeholder network. Moreover, research has indicated that IACO implementation can increase the level of collaboration between individual stakeholders (28, 29, 35). A study by Kwait, Valente & Celentano also revealed that solid interorganizational collaboration can help to improve the targeted health outcomes (22). In contrast, research has also shown that if partnership networks are strongly structured, increased collaboration (increase in network ties, higher density) does not aid implementation progress (36). Also, community approaches often give rise to centralized networks with one prominent actor or agency involved (37), which is argued to impede continued implementation (21). Finally, Ramanadhan (35) mentioned that within an intersectoral community approach addressing cancer disparities, the level of implementation was related to a) the number of collaborations (network ties) that are initiated from one sector to another (intersectoral out degree) and b) whether collaboration (network tie) was perceived as reciprocal (reciprocity).

Fundamentals of Social Network Analysis

Traditional health promotion research often explains one or more outcome variables via one or more individual characteristics. In contrast, SNA relates network characteristics or network shape to determinants and processes within the social context (37, 38). SNA is based on fundamental principles of mathematical graph theory and sociology. A network is viewed as a model of nodes, lines and arrows. Every node portrays an actor and can represent an individual, an organization or even a country. Lines (ties between actors) and arrows (direction of the tie) denote the relations between actors. Hence, the position, location or connections of the actor in the network can be evaluated, and constructs as degree (level of connectedness of an actor) and centrality (importance of an actor in the network, different types) can be calculated. Moreover, characteristics of different groups or cliques of actors can be elucidated. The network as a whole can also serve as the unit of analysis; evaluating network density or centralization (37). Finally, the change of networks

over time can be analyzed. This is still a young field of research, but its development is said to be the "next logical growth in network research" (39). The operationalization of all SNA parameters used in this study is displayed in table 1.

Study objectives

The assumptions of JOGG and EPODE regarding network characteristics and performances or their relation to IACO implementation success have not yet been substantiated with evidence. We therefore evaluated both the development of community partnership networks as well as implementation success within three JOGG approaches instated in the Netherlands longitudinally. Our research objectives were threefold:

1. To examine the degree of IACO implementation of three communities implementing the JOGG approach using the JOGG 'progress tool';
2. To examine the development of community partnership networks over time in these three communities…
   a) ..on the level of the network (size, (degree) centrality, centralization, (intersectoral) density).
   b) ..on the level of the actor (quality of ties, in/out degree);
3. To examine the relation between network parameters and implementation success at the network level, taking into account the assumptions on this relation as defined in table 2.

Table 1. Network parameters

Construct	Definition
Network size	Number of actors in the network
Network density	Total number of ties in the network
Intersectoral density	Number of ties between different sectors
Degree centrality	Total number of ties one actor has in the network
In- and outdegree	Number of ties an actor has to other actors (outdegree) and from other actors (indegree)
Highest indegree	Actor with most incoming ties, considered the 'prominent' actor in the network
Highest outdegree	Actor with most outgoing ties, considered the 'influential' actor in the network
Network (in/out) degree centralization *(fig. 1)*	Percentage (%) of the largest possible variance in the number of in- and/or outgoing ties the central actor has in comparison to other actors in the network.

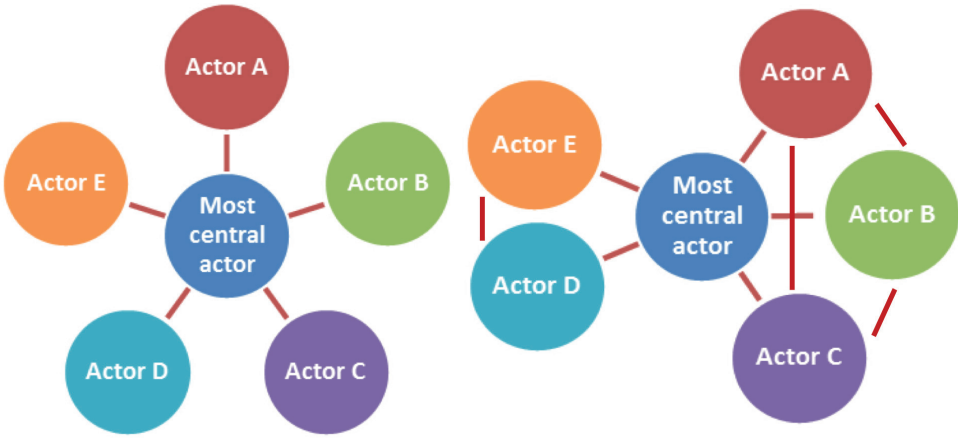

Figure 1. Network degree centralization
Network degree centralization= 100* Σ(C*-Ci) / Max Σ(C*-Ci)
(cmax= maximum value possible & c(ni) = degree centrality of node ni)

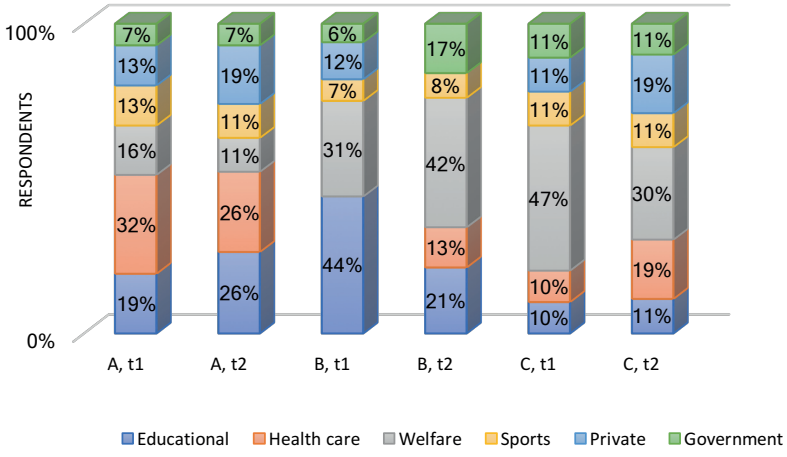

Figure 2. Sector representation per community per measurement

Table 2. Relevant JOGG program objectives and corresponding assumptions

Category	JOGG program objectives	Corresponding assumption on the relation between network parameters and implementation success	Measurement of the corresponding assumption
Actors & collaboration	There is an increase in the number of stakeholders in the childhood obesity prevention network	An increase in network size over time is related to higher IACO implementation degree at the network level	The number of actors in the network per community, per measurement will be counted and its relation to implementation degree explored descriptively.
	The network around JOGG contains a balanced composition of partners from diverse sectors.	A balanced distribution of actors per sector in the network is related to a higher IACO implementation degree at the network level	The total number of partners and the number of partners per sector (as defined in supporting information 1) will be counted. Then, the distribution of partners across sectors will be explored descriptively.
	There is an increase in the level of collaboration among stakeholders in the network.	A higher level of collaboration among actors is related to a higher IACO implementation degree at the network level.	The relation between implementation degree at the network level (measured via the JOGG progress tool) and the average level of collaboration in the network measured on a 1-5 Likert-scale will be explored descriptively.
Role of project manager	The project leader is responsible for the information flow to stakeholders about JOGG activities and themes.	A higher centrality of the project manager and subsequently the enablement of information spreading in a network is related to a higher implementation degree at the network level	The relation between the degree centrality of the project manager and implementation degree at the network level (measured via the JOGG progress tool) will be explored descriptively.
	The project manager involves local stakeholders in the JOGG approach, connects stakeholders and stimulates collaboration amongst stakeholders.	The level of network in/out degree centralization is related to IACO implementation degree at the network level	The relation between the degree centralization of the network and implementation degree at the network level (measured via the JOGG progress tool) will be explored descriptively.
	The project manager involves community stakeholders in the steering committee and workgroups.		

Methods

Sampling

Three communities implementing the JOGG approach were included via purposeful sampling (40). To obtain a sample of relevant organizations per community, we used a sequenced design with snowball sampling (36), as successfully employed in similar studies (30, 41). Hence, the project manager was asked to name all community organizations considered (potential) partners in the prevention of childhood obesity. The stakeholder most prominently involved in the prevention of childhood obesity per organization was then asked to participate. If possible, the project manager indicated which stakeholder was most prominently involved. Otherwise, the organization was contacted and asked to name the stakeholder in question. These stakeholders were asked to participate in the first network measurement. The cycle of sampling was repeated before the start of the second measurement one year later.

Research instruments

Network development was measured via network questionnaire based on Valente *et al.* (36), which measured level, form and satisfaction of collaboration. All organizations indicated by the project manager as (potential) partners for the prevention of childhood obesity were listed in the questionnaire. Firstly, participants were asked to indicate if they, in general, had collaborated to prevent childhood obesity with any other organizations in the community during the past year. If the participant answered this question in the negative, the questionnaire ended. If participants answered in the positive, the questionnaire continued and they were asked to state per organization if collaboration had been present in the past year. Participants were then asked to indicate the level of collaboration per organization. This level was represented on a five-point Likert scale ranging from 'little' to 'intensive' collaboration. Participants were also asked to indicate the form of collaboration (face-to-face and/or telephone and/or email) and their level of satisfaction with the collaboration. Satisfaction was also indicated on a five-point Likert scale ranging from 'unsatisfied' to 'very satisfied'.

Implementation of the approach at the network level was measured via a so called 'progress tool' created by the JOGG national bureau (appendix 1). This tool contains 34 questions on seven domains, namely 1) local organisation, 2) political and organizational commitment, 3) public private partnership, 4) social marketing, 5) scientific guidance and evaluation, 6) linkage between preventative and curative health care and 7) communication. Questions ranged from 'did you establish an action plan containing goals for the local community?' to 'did you monitor the local activities for all EPODE pillars?". All statements were appointed a

score ranging from one to four; one indicated that no action was yet undertaken to achieve the goal stated, two indicated that 'first steps were undertaken to achieve the goal', three indicated that 'actions to reach the goals were well under way' and four indicating that the goals was achieved. A maximum total implementation score of (34*4) 136 points could be obtained.

Procedure

Two separated measures of network development were performed in each community with a one-year interval; the first measurement took place in early 2013, the second measurement in early 2014. If possible, the network questionnaire was filled out with an participant face-to-face after qualitative data collection (42). All other participants received an email invitation to fill out the questionnaire online via Qualtrics. Non-responders received a follow up email after six weeks. If participants did not respond to the follow-up email, a phone call was made to enquire about non-participation. Participants were then again provided with the opportunity to fill out the questionnaire or opt-out of the study.

The JOGG 'progress tool' was filled out by the project manager of the approach only at t2, with assistance of a coach from the national JOGG bureau. The tool was not filled out during t1 as it was instated by JOGG in 2014; hence data on implementation at the network level is only available for t2. Next to using scores derived from this tool for research purposes, scores were also used to guide the development of future implementation plans and strategies.

Analysis

All data from the network analysis was digitalized and cleaned using Excel. Data was then transported to UCINET and visually explored to check for errors. To ensure anonymity and facilitate analysis, replies from participants were generalized and appointed to the organization as a whole. If a participant stated to collaborate with an organization, regardless of level and form, this was considered a network tie. As successfully utilized in similar studies (30), we automatically considered a tie reciprocal if one of the participants indicated that collaboration face-to-face and/or via telephone was present. If only collaboration via email was indicated, the tie was not considered reciprocal unless both participants indicated collaboration was present. Next, network parameters were calculated. We evaluated size, in- and outdegree and (average) degree centralization on the network level. On the participant level we calculated average levels of in- and out degree, and determined which participants were most prominent (highest in-degree) and most influential (highest out-degree).

The quality of relations was explored by calculating the average level of collaboration, form and satisfaction with collaboration. All network parameters were compared through time (t1=>t2) and across networks. All data from the JOGG progress tool were accumulated in Excel. Scores per domain and a total implementation score (adding up all scores per domain) were then calculated.

Results / Discussion

Characteristics of the sample

Communities differed with regard to size, number of residents, levels of income and ethnic background of its residents (table 1). As for the number of inhabitants, a ratio of 4:2:1 for resp. community A, B and C was observed. The prevalence of childhood overweight was 24% for community A, 15% for community B and 12% for community C. The highest percentage of non-western immigrants and households with a low income was observed for community A.

Response rates varied from 53-83 % (mean of 72%, table 1). These response rates have been shown to produce robust, internally valid, network outcomes(43, 44). In community A, most respondents belonged to the health care sector (t1, t2) and the educational sector (t2) (sector categorization, additional information 1). The educational sector was also most prominently represented in community B at t1, whereas the welfare sector was the largest contributor at t2. Moreover for community B, the private partners included during t1 were no longer part of the network during t2, while the health care partners took not yet part during t1, but were during t2. For community C, respondents mostly represented the welfare sector at both t1 and t2 (figure 2).

Implementation score

Across measurements, community C obtained the highest implementation score (102, max=140) and community A the lowest (84, max=140). Scores were on average highest for the domain 'local organization' and on average lowest for the domain 'linkage between preventative and curative care' (table 2). Community B furthermore scored notably lower on the domain 'public private partnership' and 'scientific evaluation' in comparison to communities A & C. Community A scored significantly lower on the domain 'communication'. These lower implementation scores for linking preventative and curative care might be related to the fact that this domain was added to the EPODE methodology especially for the Dutch setting, and in comparison little experience or best practices were available from the JOGG national bureau on how to realize this linkage(13). It is moreover known that

connecting preventative and curative care targeting childhood obesity is arduous(45), and research performed by JOGG has shown that communities need extra support to reach the objectives included in this domain(46).

Network parameters

Size of the network differed across communities and over time. Community A showed the largest and most stable network size, whereas communities B & C showed smaller network sizes that increased 20-30% in size over time. The average number of ties in the network per actor (average degree) at t1 was lowest for community B (2.98) and highest for community C (5.92). The average degree increased over time for community A and even more notably for community B, whereas a decrease was observed for community C. Previous studies have reported that a higher number of ties per actor in the network is associated with a more successful spread of information through the network (47). However, we agree with Valente *et al.* (48) that a successful spread of information might not equal implementation success. The ideal level of average degree might be context specific, and the 'more the merrier' might therefore not always be true for average degree (48). If the average degree at the start of IACO implementation or a change in average degree might be related to implementation success requires further investigation. Indegree centralization across communities and time was lower than outdegree centralization, except for community B at t1 (indegree equivalent to outdegree centralization). Project management was the most influential (highest indegree) and most prominent (highest outdegree) actor in all communities across time. An exception is community C at t1, at which school I & II were the most influential actors.

Quality of ties

Details on the quality of ties can also be found in table 1. Average levels of satisfaction were, to a great extent, similar throughout communities and ranged from 3.4 to 3.6 (scale 1-5). In all communities and across time periods, the most highly reported form of collaboration was 'face-to-face, email as well as telephone collaboration' (range 66-85%). The level (intensity) of collaboration increased from t1 to t2 in communities A&B and declined marginally over time in community C.

Table 1. Characteristics communities & network parameters

	Community A (DH)		Community B (L)		Community C (BR)	
	t1	t2	t1	t2	t1	t2
# inhabitants (municipality/ community)	510.320 / 27.400		121.249/ 13.325		180.053/ 7.345	
households with low income 2012	61%		56%		59%	
% non-western immigrants	55%		25%		17%	
Implementation site	Neighborhood		Neighborhood		Neighborhood	
Prevalence obesity children	24,3%(49) (2011, 2-16 years)		15.2%(50) (2013, 2-12 years)		12%(51) (2013, 0-11 years)	
Start of approach	2010		2011		2011	
# actors approached	44	36	22	43	23	35
Response rate	70% (31)	75% (27)	73% (16)	56% (24)	83% (19)	77% (27)
Network size	78	75	49	57	46	62
Average degree centrality	3.56	3.84	2.98	5.30	5.92	3.68
Density	0.071	0.077	0.060	0.053	0.077	0.074
Most prominent (highest indegree)	Project management	Project management	Project management	Project management	School I & II	Project management
Most influential (highest outdegree)	Project management	Project management	Project management	Project management	Project management	Project management
Centralization indegree	23%	19%	36%	45%	28%	24%
Centralization outdegree	31%	21%	36%	54%	33%	34%
Average satisfaction	3.62	3.62	3.37	3.49	3.62	3.47
Most cited form of collaboration	Face-to-face, email & telephone (66%)	Face-to-face, email & telephone (67%)	Face-to-face, email & telephone (69%)	Face-to-face, email& telephone (85%)	Face-to-face, email & telephone (74%)	Face-to-face, email & telephone (81%)
Average level of collaboration (intensity)	2.82	3.12	2.76	3.14	2.85	2.72

Table 2. Implementation score per community

Community	Local organization	Political & organizational commitment	Public Private Partnership	Social Marketing	Scientific evaluation	Linkage preventative & curative care	Communication	Total (max= 140)
A	15	12	13	12	12	13	7	84
B	18.5	15	9	12	9	12	17	92.5
C	20	15	16	12	15	10	14	102
Average	*17.8*	*14*	*12.6*	12	12	11.7	12.7	92.8

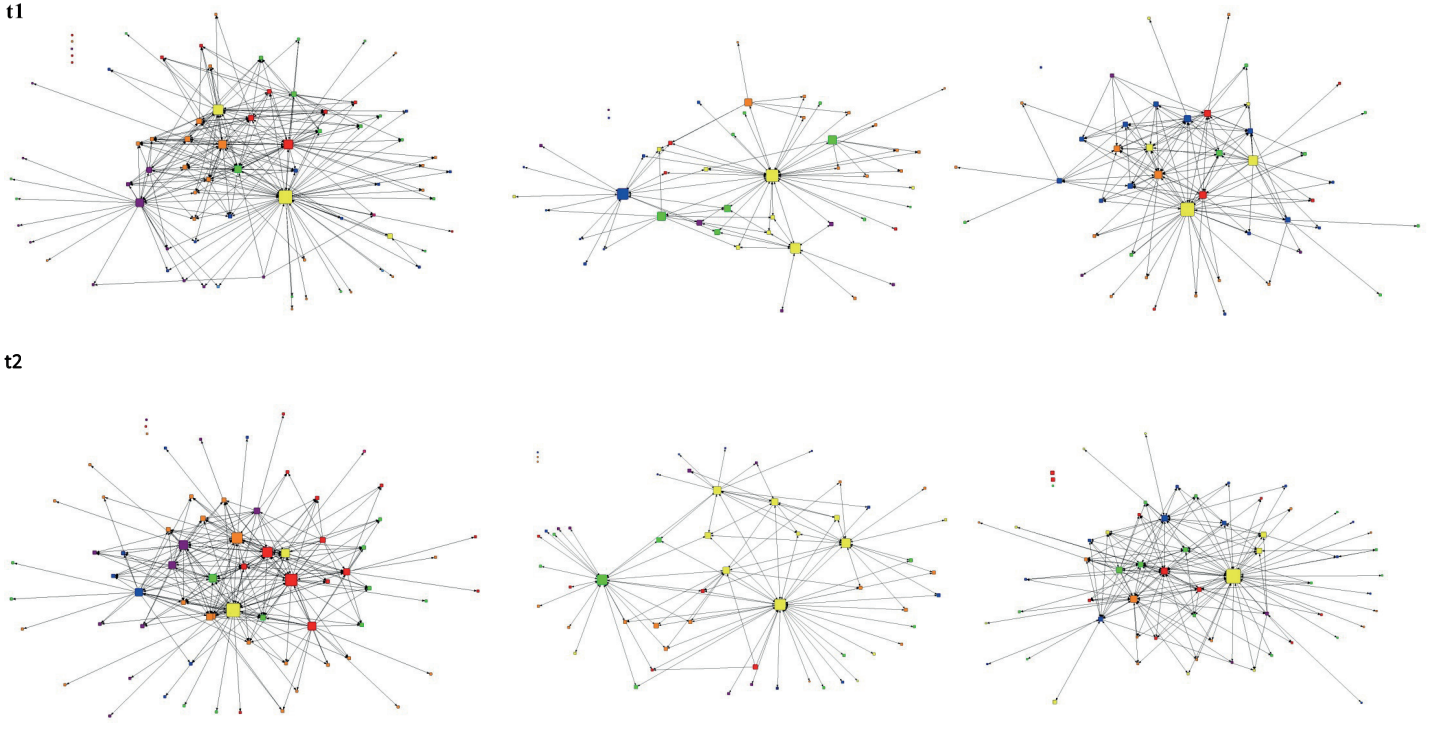

Figure 3. Centrality networks over time per community

Size of node reflects centrality; Sectors displayed as project management/ government (yellow), private (blue), sports (purple), welfare (green), health care (red), educational (orange)

Relation between network parameters and implementation degree at the network level

Network size & implementation degree

The community showing the lowest implementation degree (community A) had the largest network size over time. In contrast, the network sizes of community B & C where almost the same, whereas their implementation degree differed ten points (92.5 vs. 102 points). This might indicate that a larger network size is associated with lower implementation degree, but that a smaller network size is not necessarily associated with lower implementation degree. We moreover found an increase in network size for communities B & C and not for community A. This might suggest that an increase instead of a larger network size throughout time is associated with higher implementation degree. That being said, it should be noted that we could not account for community size in this descriptive comparison. Community C for instance had the smallest population. Its network size however was larger at t2 than that of community B, whose population was almost double the size. Community C moreover received the highest implementation score. It might thus be so that the network size of community C is, in relative terms, the largest and thus associated with implementation degree. Other studies did find an association between network size and network performance for public health interventions (21, 52, 53). A study with a larger sample of communities taking into account community size is needed to verify this assumption.

Distribution of actors per sector in the network & implementation degree

All communities, at both measurements, show an unbalanced distribution of partners within the network (figure 1). The most unbalanced distribution of partners at t2 is observed for community B, whereas the most balanced distribution was observed for community C at t2. Hence, this would indicate that a balanced distribution might be associated with successful implementation, but that an unbalanced distribution might not necessarily be associated with unsuccessful implementation. A remark should however be made in how we interpreted '(un)balanced'. For analytical purposes, we chose to operationalize a balanced distribution of partners as an equal (in number) distribution of partners across the six sectors defined. It is however so that not all six sectors are to be equally involved in the implementation of the IACO; every community can decide for themselves which sectors should be involved and which (and how many) IACO activities they will be prescribed. Hence, one could argue that it is only possible to determine whether the distribution of partners is 'balanced' if the number and content of the activities prescribed to the different sectors is taken into account.

The level of collaboration & implementation degree

The average level of collaboration in communities A & B increased from resp. 2.82 and 2.72 to reps. 3.12 and 3.14. In community C, the average level of collaboration decreased from 2.85 to 2.72. As community C was appointed the highest implementation score, this might indicate that a decrease in the level of collaboration is associated with a higher implementation degree, whereas an increasing level of collaboration might be associated with a lower level of implementation. At first glance, the association between high implementation degree and decreasing collaboration efforts might seem counter-intuitive. In previous IACO implementation studies, solid collaboration efforts has also been related to higher and not to lower levels of implementation degree (17). However, the association found might be based on 'a decrease in the level of collaboration over time' instead of 'a low level of collaboration throughout time'. As collaboration is considered a pre-requisite for IACO implementation success, one could imagine that a low level of collaboration might lead to IACO implementation failure. If actors however only decrease their level of collaboration, this might indicate that implementation is running smoothly and that they require less support from other actors to continue their successful implementation efforts. The opposite association found then might also make sense; actors might increase their collaborative effort if there is a risk for implementation failure.

The centrality of the project manager & implementation degree

Project management was the most central actor in all communities at t2. As implementation scores differed, this indicates the centrality of project management in itself might not be associated with implementation degree at the network level. Other studies have reported an association between high centrality of one or two actors and network performance (54-56). The lack of association we found might be due to the limited number of communities we could include. Project management was the most influential and most prominent actor in all three communities across time, except for community C at t1. Using these data, it is therefore not possible to verify whether a community network that has another most central actor would have performed better or worse with regard to IACO implementation.

Degree centralization of the network & implementation degree

Centralization in-degree (the level of variance in the number of incoming ties between the most central actor and other actors in the network) declined for communities A & C and increased for community B over time. Centralization out-degree (the level of variance in the number of outgoing ties) declined over time in communities A & C, whereas an increase in centralization out-degree was observed for community B. Overall, both in- and outdegree centrality were highest for community B, followed by community C and A. Hence, community B showed the largest increase in degree centralization over time and

the most centralized network in general. Community A had the least centralized network throughout time and showed the largest decrease in degree centralization over time. As community A obtained the lowest implementation degree, our data might indicate that a less centralized network or a decrease in centralization over time is associated with lower implementation degree. The association between a decrease in degree centralization and lower implementation degree might be explained by the central role that project management fulfilled in community A. For centralization to decrease, especially the most centralized actors (such as project management in community A) need to scale down their collaborative efforts. A decrease in project management collaborative efforts has often been reported to result in poor implementation sustainability, because other actors still expect project management to lead the way. These actors then do not show sufficient collaborative efforts themselves to compensate for the loss of effort by the project management (57). Hence, it might be so that the decline in centrality of project management instead of low centralization on its own is related to the drop in implementation degree. Supporting this hypothesis, a network that is decentralized from the beginning has been named to facilitate the adoption of innovations and long term implementation, whereas networks starting centralized have been related to determinants impeding IACO sustainability (17) such as fewer attempts at shared decision making amongst partners and lower commitment of partners to implement health promotion interventions (21).

Strengths & limitations

The use of an SNA questionnaire of Valente *et al.* (36, 58) can be counted among the strengths of this study. This questionnaire has been used in similar previous studies to successfully measure network development over time (21, 27). Furthermore, network development was evaluated longitudinally, which provided new insights into the relation between network development and implementation success. Some limitations of our study should however also be noted. Our study was merely exploratory. We used descriptive analyses to study the hypotheses stated by EPODE, no statistical analyses were performed. We therefore suggest future studies consider the use of multi-level statistics to (dis)confirm the results of this study. For example methods developed especially for social network analysis such exponential random graph models (P-models) (59-62), which allow for the statistical analysis of patterns or variances of network (performance) within networks involving multiple actors or groups. We furthermore could only include three communities in our study, and had only one measurement of implementation degree (namely at t2). It was therefore not possible to see whether implementation degree changed over time, and to draw definitive conclusions from our results. Moreover, implementation degree was self-reported by project management. Previous studies have shown that self-report of implementation behavior can be prone to bias (63-65), and results should therefore be interpreted with

caution. Finally, we encountered some drop-out of participants from t1 to t2. Although the response rates obtained have been shown to produce robust, internally valid, network outcomes (43, 44), we argue that our findings (especially in- and outdegree and the quality of ties) might be influenced by the participant drop-out. One could for example imagine that those actors with a lower in- and out degree, lower levels of collaboration and/or lower levels of satisfaction (and therefore less collaborative effort) might be more prone to drop out of the study, leading to inflated outcomes on these parameters.

Conclusion

This study examined network development and IACO implementation degree within three communities implementing the EPODE-derived IACO 'Youth on a Healthy Weight'. We furthermore evaluated the relation between specific network parameters and implementation degree at the network level, taken into account the assumptions on this relation as defined by EPODE and JOGG. To our knowledge, this is the first study to evaluate if and how network development over time is related to implementation degree within IACOs. It provides new insights into how IACO community partnership networks develop longitudinally and whether its network parameters associate with implementation degree. EPODE considers the establishment of a community partnership network as a prerequisite for successful IACO implementation (13). It states that childhood obesity can only be countered if all relevant partners within the community, both private and public, are mobilized to create a non-obesogenic environment. It is furthermore mentioned in previous studies that several aspects necessary for successful IACO implementation, such as community capacity and a broad spectrum of (human) resources and expertise, can only be mobilized if community partners work together to reach intervention goals (66-68). Our findings are partly in line with these statements about network development and implementation success; three out of five of the JOGG assumptions on network development and implementation success were (partly) supported by our results. However, we also found that other network characteristics and parameters were of possible influence on IACO implementation success. Previous studies have moreover revealed that network characteristics or parameters do not only influence implementation success but that implementation success also influences these variables. For instance, studies have found that if more IACO activities are implemented successfully and this success is visible to community partners, they are more likely to initiate, improve or intensify collaboration efforts (48). From our data, we are not able to deduce whether this circular relationship is also relevant or applicable to the communities included in our study. We do however argue that it is important to keep in mind that this relation is potentially reciprocal. Hence, improving implementation efforts by influencing other determinants of IACO implementation (17) might lead to a higher degree and quality of

collaboration and thereby further optimisation of implementation integrity. We also found that this relationship between network characteristics and IACO implementation success might not (as) static as proposed in the assumptions made by EPODE and JOGG. The change in network parameters over time instead of network parameter outcomes at one point in time might be associated with implementation degree. Future studies, including a larger number of communities, might be able to shed light on this presumption and elucidate whether certain changes as opposed to constancy in network parameters are associated with IACO implementation success. Finally, the results of this study offer indication on how network development strategies can be formulated to optimise IACO implementation. This could also be used to direct future studies and the development of EPODE program methodology, for example by testing in vivo whether these strategies can influence IACO implementation.

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General discussion

8

General discussion

The aim of this discussion is to further explore the results and practical implications of this dissertation; both for IACO implementation in general and for implementation within each of the five sectors introduced in chapter one in specific. Sector specific findings will be illustrated by means of the vignettes presented in the introduction.

Were the IACOs implemented as intended?

The measurement and comparison of implementation degree across IACOs proved to be challenging in our studies. The paragraph below illustrates how we came to conclude that (1) there is still no golden standard on how to use or operationalize indicators of IACO implementation, that (2) we were not able to verify if most of the IACO activities prescribed were implemented as intended because they were not protocolled, (3) adaptation of IACO activities might be necessary to ensure a good fit with the local context, and that therefore (4) it might be better to measure conceptual use instead of mechanical use (such as strict adherence to protocol) to determine implementation integrity.

First, we struggled with the decision on which indicators of implementation degree we would measure. In our systematic literature review we found a diverse pallet of indicators. Even if the same indicators were used across studies, their operationalization varied greatly. We therefore could not derive the 'golden standard'[1]. After rigorous debate, we decided to measure implementation indicators as described in the widely cited implementation indicator framework of Peters *et al*.[2] We measured the degree to which the IACO was put into practice and referred to this indicator as 'adherence'. We however also used 'completeness' to refer to this degree of implementation in *chapter 4,* as peer-review feedback indicated that this term was more familiar to the intended target audience of that particular journal. This underlines our review finding that even within the relatively small field of research on health promotion implementation, the use and operationalization of implementation indicators is still fuzzy. This fuzziness gives rise to Babylonian language confusion, and makes comparability and replication of study results difficult. We therefore argue that researchers should strive to reach and adopt consensus on the use of implementation terminology and its operationalization, for example by further developing the consensus on implementation measurement indicators proposed by Rabin *et al*[3].

The second challenge we faced was the striking difference in the number of IACO activities prescribed to local stakeholders included in our study, and the level to which these activities were protocoled. Stakeholders embedded in three out of five of the included IACOs were prescribed only a small number of activities and were only provided with general instructions on how to execute the activities prescribed (i.e. *organize an activity to*

stimulate physical activity). We argued that simply recording if *'an activity to stimulate physical activity'* was performed would not provide optimal insight into IACO implementation integrity. We therefore asked project managers from those IACOs that prescribed only non-protocoled activities to provide additional details on those activities. This approach of further enquiry also supported our semi-action research design[4,5]; one of the project managers for instance mentioned during an interview that *"By providing additional details, I was challenged to contemplate further on what we wanted exactly from local stakeholders. This sharpened my focus"*. Project managers were however unable to provide additional details for one third of these activities. We then decided to consider this as a true reflection of the IACOs implemented, and included all activities prescribed, both protocoled and non-protocoled, in our so called 'yes/no implementation adherence checklist' that was filled out by stakeholders at several moments in time. However, the inclusion of these non-protocoled activities gave rise to the question how we would ensure we were not comparing cheese with chalk. In our quantitative study, the issue of comparing 'cheese with chalk' became apparent. We wanted to compare implementation degree across IACOs and evaluate the relation between determinants of implementation and implementation degree. Descriptive analysis however confirmed our observation that the number of activities prescribed per IACO and stakeholder ranged widely, and that the number of activities was negatively associated with the level to which activities were protocoled. We attempted to prevent the 'comparison of cheese with chalk' by including the number of activities prescribed as a determinant in our multivariate analysis. This analysis revealed that the number of activities prescribed was indeed significantly associated with implementation degree. If more activities were prescribed, this was associated with a lower degree of implementation. On the one hand this sounds logical; it has been reported that if a high number of activities is prescribed, this can enhance a feeling of complexity and thereby hinder implementation[6-8]. However, a low number of non-protocoled activities can also cause procedural unclarity and lead to unsuccessful implementation[9]. The association between the number and level to which the prescribed activities were protocoled might also be explained by two forms of measurement bias. First, statistical measurement bias. If more activities are included, the chance of one not being completed rises. Second, content measurement bias. Imagine a stakeholder who implements 70% of the prescribed *'activity x'*. If this stakeholder is asked to indicate whether '*activity x was implemented as a whole*', he might be more prone to answer in the positive (and thus receiving an 100% completeness score) than if a stakeholder is asked to indicate for all elements of *'activity x'* separately whether they are implemented. So although we made significant effort to develop valid indicators for the assessment of degree of program implementation, considering the before mentioned potential biases and the association found, the question remains whether we succeeded. One innovative approach proposed by Hawe *et al.*[10] might provide leads on how to measure implementation degree

across IACOs in future studies, without risking comparing cheese with chalk. Hawe *et al*.[10] argue that the implementation of complex interventions should not be viewed as 'one-dimensional, program delivery' but rather as a 'complex event in systems'[11-13]. In line with this view, they do not approve the measurement of 'classic' fidelity as described in the Research & Dissemination (R&D) paradigm[14]. They feel the measurement of such fidelity does not do justice to the good intentions of stakeholders who abandon implementation fidelity by adapting activity elements. They instead state that stakeholders know best how their 'complex system' resides, and how elements can be adjusted and embedded in such a manner that intervention effect can be preserved. In classic fidelity measurement, adaptation lowers the fidelity score because the element is then not performed as prescribed by the developer. However, especially for complex interventions, adaptation of elements by stakeholders who are skilled and knowledgeable with regard to the intervention (known as 'conceptual use'[15]) has been associated with increased program effect. These adaptations might then not be put away as an undesirable lack of fidelity[24;28;34;40-46]. Hawe *et al*.10 further state that one should therefore not measure to what degree an activity protocol is implemented, but to verify if intervention functions (which could be reached via a variety of activities) are implemented with fidelity. Hence, intervention theory instead of intervention protocol is informing the design of the IACO process evaluation. This would allow room for adaptation by local stakeholders in accordance with the local context, as well as a more valid evaluation of implementation integrity. Nevertheless, as mentioned before, IACO activities were mostly not protocoled. It therefore might also be difficult to distillate if and which intervention theories underpin these activities. We therefore argue that although intervention theory might be a more appropriate basis for the assessment of IACO implementation integrity. This implies that a clear description of IACO activities is still needed to identify which intervention theories should be tested.

Also in our we could not yet determine on which intervention theories certain program elements were based. We were therefore not able to make a clear distinction between favourable and unfavourable adaptations of certain program elements. In general, we know to some extent which activities can contribute to a decline in childhood obesity[16-21] but not which specific activities are most critical for the decline[17]. Especially for complex community programs such as EPODE-derived IACOs, it remains unclear which IACO activities are needed to reach the intended intervention effect. Moreover, in our study we could not determine if stakeholders were skilled and knowledgeable enough to determine which and how elements could be adjusted without loss of implementation integrity. In accordance with Durlak[22], we would therefore advise future research initiatives to elucidate which intervention elements and related conditions for effective application have to be taken into account in order to reach the desired health-related impact by EPODE-derived IACOs. The recent WIDER checklist published by Albrecht *et al.*[23] could provide opportunity

for the EPODE national agency, in close collaboration with IACO project managers, to better describe the conditions for effective implementation at the local level. We moreover advise future researchers to take into account the adaptation/fidelity debate, and untangle how and if conceptual use and thus possible adaptation of certain activity elements can lead to improve the impact of IACO interventions.

Which determinants influenced IACO implementation?

We identified a variety of IACO implementation determinants across studies. The Fleuren model[9] proved partly sufficient to categorize these determinants. Some determinants we identified were however not included in the original model. To accurately categorize these new determinants and remain true to the specific characteristics of IACO implementation, we added the category 'intersectoral collaboration' to the Fleuren model and amended the category 'social-political context' into 'community & context'.

Some of the IACO determinants identified were found to be critical in multiple sectors, whereas other determinants were only found to affect IACO implementation in one (or two) specific sectors. A determinant was considered to be a relevant target for change in multiple sectors if it was found in at least ≥3 out of 4 sectors (table 1).

Which determinants were found to influence IACO implementation in multiple sectors?

Determinants of the professional

Perceived ownership (participants expressing they felt "personally tied or attached to IACO goals"[24]) and high perceived importance of IACO goals were identified as key facilitators to IACO implementation across sectors. These associations have been widely reported; for health promotion innovations[25], complex community programs[26,27] and also IACOs in specific[28]. However, our data revealed that implementers who were less successful also stated that they felt high ownership towards IACO goals. This could perhaps indicate that high ownership is a condition for successful implementation, but not decisive per se. This presumption is reinforced by the causal configurations of determinants we identified in our qualitative studies, which for instance indicate that the combination of (1) high ownership, (2) sufficient possibilities to adapt, and the absence of (3) any perceived barriers leads to implementation success. Hence, 'the whole might be greater than the sum of its parts"; and ownership should possibly be not considered in isolation. This hypothesis that the whole might be greater than the sum of its part is partly supported by research from Armbruster *et al*.[27]. They found that the feelings of 'ownership' and 'participation in program development and planning' were interrelated; (early) participation in planning and development led to a better fit of the intervention with the needs and wishes of the participant, increasing

ownership of intervention goals. In line with another recent review of reviews[29], one could then argue that IACO implementation might be optimized by formulating multi-faceted innovation strategies targeting a combination of interacting determinants, including ownership. We however support the vision as expressed by Harvey & Kitson[30], that it is not an either/or discussion. Instead, implementation strategies for complex intervention should consider implementation as a complex process and formulate implementation strategies, multifaceted or single, accordingly.

Stakeholders' self-efficacy towards IACO implementation was also found to influence IACO implementation across sectors. This finding is relatively new for integrated approaches; the association has only been addressed by one other IACO implementation study.[31]. That being said, several other health promotion innovation studies[32-34] and implementation theories[35],[36] do confirm the association found between self-efficacy and implementation success. We furthermore found indications that especially high self-efficacy in combination with high ownership leads to a higher implementation degree. Few studies have researched if and how self-efficacy in combination with ownership influences (implementation) behavior[37]. Most implementation studies focus on elucidating which determinant influence implementation, and not on which or how determinants intertwined or jointly lead to implementation success. This, again, addresses the issue of 'the whole being greater than the sum of its parts', and the need for more research on how determinants jointly or in interaction influence IACO implementation. In our studies, we aimed to bridge this gap by using an adapted version of QCA to evaluate if determinants in configuration could lead to a specific outcome. This provided us with indications that in some cases, determinants in configuration rather than stand-alone determinants influence IACO implementation. Because of the limited number of cases that could be studied, no definitive conclusions can be drawn from our QCA results. Hence, we consider the use of QCA in our study as an important step forward towards elucidating if 'the whole is greater than the sum of its parts', but we feel that there is still a world to be conquered. We argue that the adapted version of QCA should be tested using a larger number of cases, and that its methodology should be further refined for use in IACO implementation studies. A next step would then be the translation of QCA findings into implementation strategies, which could further inform the debate mentioned earlier on the use of multifaceted or single implementation strategies.

We found that time of experience with IACO implementation was positively associated with implementation adherence; Stakeholders who implemented the IACO activity for more than twelve months showed a higher implementation degree in comparison to novel implementers (<12 months of experience). Rogers also mentioned this association between time and implementation success in his diffusion of innovations theory[38], stating that stakeholders who sustain implementation are most often better

implementers. So what could explain this association found between time of experience and implementation succes? We argue that selection bias might mediate the association found. Those stakeholders that sustain implementation are perhaps on average more motivated to implement the innovation, and therefore might be better implementers. The health promotion implementation literature remains indecisive about the direction of the association between time and implementation success. Young *et al.*[39] found that implementation of the IACO 'TAAG' improved over time, whereas two other studies[40,41] reported that the implementation of a health promotion program in schools worsened over time. However, for IACOs in specific, Bolton *et al.*[42] reported that the 'allocation of sufficient time for implementation' was one of the key factors to reach (continued) implementation success. We argue that more longitudinal IACO implementation studies are needed to further elucidate the relation between time and implementation succes. This also provides oppurtinity to verify if other determinants mediate the relation between time and implementation succes, for example by using the previously mentioned QCA method.

Innovation

A 'high compatibility of the activities prescribed with existing working procedures' and 'possibilities to adapt IACO activities to improve their fit with the local context' were identified as key facilitators to IACO implementation across sectors. We feel this finding further strengthens the recommendations we made with regard to the fidelity/adaptation debate described earlier in this discussion. Stakeholders strongly express that multiple possibilities to adapt and high compatibility of activities with their existing (work) procedure facilitates their implementation efforts, but it is not yet known which activities can be adapted (and to what level) without loss of fidelity and intervention effect. More research is thus needed to determine which activities (elements) are critical for intervention effect, and how implementation integrity can be evaluated if (certain) adaptations are not considered as a loss of fidelity. If we dive deeper into the issue how IACO activities should or can be adapted, research indicates that adaptation informed by both top-down (for example project management or research) and bottom-up (local stakeholders) forces is most beneficial to the implementation of complex health promotion programs[43,44]. This approach is referred to as a 'mutual adaptation[45]'. A mutual adaptation approach also aligns with the principles of community participatory action research[4] (CPAR), as it provides opportunity to enhance the match between stakeholders' needs and IACO activities. In our opinion, a mutual adaptation approach guided by CPAR could create an optimal environment to successfully implement an IACO. However, as Muhammad *et al.*[46] recently noted, power and identity equality between researchers and local stakeholders is an important prerequisite for this approach to be successful.

Organization

Our quantitative study revealed that formal ratification was negatively associated with implementation adherence in multivariate analysis, while a positive association was found in univariate analysis. In previous studies only a positive association was reported; that formal ratification was related to IACO implementation succes[47-53]. Because of this contradiction between the results of the univariate and multivariate analysis, we explored these findings from our quantitative study further. The correlation matrix then revealed that formal ratification was only negatively associated with implementation adherence for educational sector stakeholders embedded in communities A or B. This means that in multivariate analysis, the regression weight of the determinant 'formal ratification' was heavily affected by 'educational sector membership'. This association between formal ratification and sector membership is not reported in earlier studies. However, the Centre for Disease Control (CDC) does emphasize in their report "*Make a Difference at Your School*" that one of first steps of successful implementation of health promotion programs in schools is the inclusion of (specific) health promotion goals in the schools' policy[54]. One other possible explanation for the negative association found is that the presence of formal ratification might indicate that the intervention was implemented top-down. in previous studies, a top-down implementation has been related to lower degrees of continued implementation[55]..

Community & context

We found that if partners were more equally distributed across sectors in the network, this was associated with a higher implementation degree. We also found that a higher level of network centralization, meaning a high level of variation in the number of ties per network partner, was related to a lower level of implementation degree. These findings can both be explained if one considers the association frequently reported between these network characteristics, network stability and continued implementation success. If a network is stable and partners continue to work jointly towards network goals, this associated with higher levels of continued implementation. A centralized network, as we found in our study, has however been associated with a decrease in network stability over time[56], and might therefore have contributed to a decrease in implementation degree over time. Especially if the involvement of the most central partner is dependent on external resources, the network is more likely to become unstable and implementation degree will decline if resources are cut[57].

An equal distribution of partners has also been associated with a more stable network over time, and in turn a better chance at continued implementation success. We argue that an equal distribution of partners might enhance network stability because the network is not dominated by one particular sector on which other sectors depend for continued collaboration and implementation. Also, the network might be more stable as sector

involvement, is for the greater part not dependent on a single actors' collaborative effort. Then, the retreat of one partner does not cause a complete sector to be eliminated from the network. We therefore advise future IACO project managers to stimulate the participation of stakeholders from a variety of sectors within the community. That being said, it should be noted that network development within complex interventions is complex and is not only influenced by the network characteristics mentioned above[58]. Other factors such as trust, knowledge about the other organisations[59], feeling a shared commitment for action and cohesion in the network can also influence network stability and output[60]. More research is needed to verify which factors are most important to enhance IACO implementation success, and which of these factors are mediated by levels of network stability.

Practical implications

- Next to an intervention action plan, we advise practitioners to develop s**trategies for the implementation** of their IACO in close collaboration with local researchers (for example from the Municipal Health Services (GGD)) and local stakeholders. These strategies should then be revised and adapted regularly to ensure their fit with the needs and wishes of the local context. The implementation of an IACO is complex and without such a dynamic plan, implementation failure is a much greater risk.
- In accordance with a recent study by Bolton *et al*.[42], we urge that **sufficient time should be allowed** for IACO implementation. EPODE only showed results after ten years; it takes time to build a lasting network and most implementers need time to get acquainted and be successful IACO implementers.
- Across sectors and in time, **high ownership of IACO goals** and **feelings of high self-efficacy** towards implementation were related to IACO implementation success. We therefore advise to take these determinants into account when developing implementation strategies. Self-efficacy for instance has shown to be enhanced by regular coaching sessions throughout the implementation process[61], whereas ownership of clinical guideline use was enhanced by ensuring that practitioners were involved in the development of the guideline.
- We found that if **collaboration with community stakeholders** is perceived as fruit- and successful, this was related to implementation success. It might therefore be wise to stimulate solid collaboration, for example by organizing regular stakeholder meetings and making the benefits of collaboration visible to stakeholders.
- **A non-centralized network** was related to implementation success. We therefore advise to not let only one stakeholder (for example the project manager) be central to the rest of the network partners, as this might jeopardize a feeling of shared responsibility for implementation and network stability overtime.

Table 1. Overview of key determinants for IACO implementation in multiple sectors, per sector and during initial or continued implementation

	Professional		Innovation		Innovation strategies		(Intersectoral) collaboration		Organization		Community & Context	
	Initial	Continued	Initial	Continued	Initial	Continued	Initial	Continued	Initial	Continued	Initial	Continued
Common for multiple sectors	High Ownership[4,5] High self-efficacy[5,6] Long-time of experience with IACO implementation (>12 months)[5]		High compatibility working procedures[4] Sufficient possibilities to adapt[4] High number of activities[5] Incompleteness[6]						Formal ratification IACO[5]		Equal distribution of actors per sector[7] Centralized network[7]	
Educational sector	Lack of time /resources[6]	Low priority for implementation[4,6]	Low instrumentality[6,4] Implementation causes disadvantages[4]		Lack of reinforcement strategies*[6]							
Private sector	Feeling morally obligated[6]		Lack of observability of implementation[6]				Lack of shared commitment[4,6] Solid external collaboration[6]		Goal compatibility (barrier[4], facilitator[6])	High turnover of staff[4]		Low participation of target population[4]
Health care sector				disorganization IACO[4]		Regular evaluation of implementation[6]			Organizational turbulence[6]	Coordinator for implementation available[4]		Limiting factors target audience[4]
Welfare & sports sector				Advantages caused by campaign use[4]			Unsolid external collaboration[6]		Insufficient financial resources[6]	High goal compatibility[4]		

[4] chapter 4, [5] chapter 5, [6] chapter 6, [7] chapter 7, *initial* initial implementation, *continued* continued implementation. Barriers in red, facilitators in green. If a determinant was considered a barrier in sector A and a facilitator in sector B, it was considered as a sector specific barrier or facilitator.

Which determinants are found to influence IACO implementation within a specific sector?

Educational sector

James, 52, primary school teacher

I strongly support the goals of the IACO; children should be healthy and fit! However, my students messed around with their water cans, which resulted in one very wet classroom. The cans also began to smell after a while; the children did not clean them very often. Moreover, the government rates the quality of our school based on the academic achievement of my students, not on the students' health status. Because I'm all ready short on time, I therefore commit the resources I have available to teach some extra mathematics. That leaves me with too little time to perform all of the IACO activities. I did integrate the water breaks and fruit moments into our daily class schedule. In that way, I was able to sustain some of the IACO activities over time.

An important finding of this dissertation is that in specific for the educational sector, determinants related to the professional and the innovation were found to be most influential to IACO implementation. Only for these stakeholders, 'limited time and resources' and a 'lack of priority for IACO implementation' were identified as key barriers. Hence, these stakeholders expressed that their sparse time and resources were committed to optimize students' academic achievement, leaving insufficient resources to implement IACO activities. Previous studies have also reported that a low priority for health promotion in the educational sector[62,63], partly caused by a government-led demand for and focus on academic acheivements[64,65] impeded the implementation of health promotion interventions. We argue that one possible solution to optimize IACO implementation within the educational sector is to make stakeholders, local policy makers and national government officials more aware of the strong positive association found between healthy behavior of children and academic achievements[66-68]. If this awareness then translates into a shift in government demand and funding, this could contribute to the prioritization of health promotion in schools.

Also solely for educational stakeholders, a 'lack of external aid and incentives to continue IACO implementation' was identified as a key barrier. Economic theory underlines this finding and states that the 'principal' (the innovation) needs to encompass procedures to incentivize the 'agents' (professionals) to optimize implementation[69]. Continued reinforcement, for example

in the form of (dis)incentives and iterative implementation support, is furthermore included in the recently published expert recommendations for implementing change[70]. Skinner[71] was one of the first to mention that behaviour change can be accomplished by providing rewards directly after a certain behaviour was performed. However, for this strategy to work properly, it is important to keep in mind that the reinforcement should be aimed at the behaviour, and not at the result of the behaviour[72]. For example, a teacher should be rewarded for the implementation of the regulation to eat healthy snacks during the morning break, and not for the number of children that are eating healthy snacks. So should we then instate as much external reinforcement strategies as possible to ensure (sustained) IACO implementation? We argue that this could potentially be harmful, and advise project managers to be cautious whilst instating such strategies. External reinforcement has namely been reported to decrease stakeholders' (potential) internal motivation to perform a prescribed behaviour[73]. This corroborated by one of the (sustainability) aims of EPODE, which states that to ensure continued implementation of an IACO, external reinforcement should be limited. Instead focus should lie with the establishment of community readiness, (lasting) resources and the recruitment of internally motivated local program champions[74,75]. Therefore, although professionals call for continuous reinforcement of IACO implementation, the form and level to which it is instated should be considered carefully to avoid a decrease in stakeholders' internal motivation to implement or a decline in available (human) community resources.

Practical implications

- James encountered negative effects of the implementation in his classroom. **A mutual adaptation approach**[45] or regular evaluation of his implementation might have obviated this problem, as James would have been consulted about his (negative) implementation experience and the activity could have been adapted in collaboration with James. **Piloting of the IACO activities prior to widespread implementation** might also have uncovered these issues.
- James named that implementation was impeded because the government appraises his school only on the academic achievement of its students. We therefore advise future IACO project managers to not only implement IACO activities on the local level, but also to try to **influence policy making at the local level**[76]. For example 'the healthy school' program that was launched by the Dutch government in 2013 could, if correctly timed and feasible, provided incentives to schools to facilitate the (continued) implementation of IACO activities[77].

- **External reinforcement and aid** for IACO implementation is important to James, as he indicated his workload is already overwhelming. In accordance with the Centre for Disease Control[54] we would advise to facilitate James' IACO implementation by establishing a school health counsel and/or to appoint a coordinator who could make plans and formulate strategies to reinforce (future) IACO implementation.

Health care sector

Fatima, 31, youth health care nurse

I was really happy that we could participate! My work is already focused on optimizing the health of children, so this program really complemented my other tasks. However, during the implementation of the IACO, our organization was merged with other youth health care facilities into the Center for Youth & Family (CJG). Times were quite turbulent; intervention materials got lost during the move and we needed to establish a new status quo. Initial implementation of the IACO was therefore troublesome. I also encountered that during previous interventions, parents and children were not always able to comply with IACO goals because of financial and behavioral problems. Some parents just couldn't afford to buy healthy food. Luckily, a coordinator was appointed in our organization for the implementation of the IACO. She send us emails with instructions on how to perform the activities prescribed, an how to tackle the hurdles we encountered. We also came together regularly to evaluate the progress of the IACO. That really helped me to (keep) the activities going!

A notable finding is that the key determinants to IACO implementation identified for this sector were mostly related to the match of the IACO with their regular practice or previous experiences. We for instance found that solely within this sector, IACO implementation was facilitated by the availability of an internal coordinator and regular evaluation of the campaign. However, the health sector was the only sector included where the appointment of a coordinator and regular evaluations were considered regular practice. Hence, the established regular practice within this sector encompassed certain conditions that were found to facilitate IACO implementation, also in previous implementation studies[50,78-80]. We do however argue that finding these determinants to be relevant only for this sector might be due to the concept of 'you don't miss what you don't know'. In other words, stakeholders from the other sectors might not be able to

asses which benefits the appointment of a coordinator or regular evaluation would have had on IACO implementation as they haven't previously experienced the benefits of these actions. Whether this assumption is true needs to be further examined.

Health care stakeholders also mentioned that their day-to-day work and the IACO activities prescribed were highly compatible, highlighting again the match with existing practice. It might be easier to implement health promotion activities in a sector which primary aim is already to optimize the health of children, then for example within the educational sector where the major aim is to optimize the academic achievement of children.

Finally, certain attributes of the target population, such as financial or behavioral problems, were only identified as key barriers to IACO implementation in the health care sector. Health care stakeholders for example mentioned that their clients did not have sufficient financial resources to buy healthy foods or that they were unable to comply with healthy diet suggestions. Several other studies reinforce our finding that target population attributes can affect IACO implementation[50,80,81]. We argue that the previous experience in this sector with financial or behavioral problems of the target population might explain our finding. A majority of the health care professionals expressed that during previous health promotion interventions, the target population was often not able to participate in activities or activate behavior change. These experiences might have given rise to a negative presumption about the these attributes of the target population while implementing this IACO, resulting in some degree of confirmation bias[82]. They therefore were perhaps more prone to watch for these attributes in the target population, and report them in the negative. Whether this bias was actually present, or whether compliance was actually worse or more important for stakeholders in the health care sector needs to be further investigated.

Practical implications

- Fatima named that her implementation was facilitated because the prescribed IACO activities fitted perfectly with her existing work assignments. This underlines the importance of a **proper fit of the IACO with the local context**.
- Turbulence within the organization caused a decline in Fatima's IACO implementation. Because of the turbulence, additional tasks such as IACO implementation were easily put on the back burner. Countering shared responsibility bias, it might help to **explicitly divide subtasks with regard to IACO implementation amongst stakeholders,** and to **send extra (email) implementation reminders** to encourage continued implementation efforts.
- According to Fatima, parents and children were often not willing to comply with IACO activities. **Training that touches on the possibility of non-compliance of the target population** and for example, teaching motivational interviewing techniques

to health care stakeholders could possibly increase stakeholders' self-efficacy towards addressing the non-compliance of parents and children and decreases their lack of implementation motivation[83].

- **Appointing an implementation coordinator or champion** and **regular internal evaluation** of the campaign were named by Fatima as facilitators to implementation. This highlights that organization wide support and commitment to IACO implementation can lead to greater IACO implementation success.

Welfare- & Sports sector

Jeffrey, 22, Youth welfare worker

I really tried to implement the IACO, because i feel that it is important to promote a healthy lifestyle in children. However, we had insufficient financial resources to implement certain IACO activities. We, as welfare workers, focus on many societal issues such as poverty and domestic violence, leaving little resources left to implement IACO activities. Also, collaborating with community partners to implement IACO activities was very difficult and time consuming. In my opinion, the benefits of IACO implementation did not outweigh the effort required to implement them. On the positive side; i do feel that we strive to reach the same goals as IACO project management. We both want children to feel good and happy and live long, healthy lives. That feeling makes me want to try hard to implement at least some of the IACO activities prescribed.

None of the key determinants identified for the welfare and sports sector were related to the professional. Primarily external determinants (related to the organization, innovation and to organizational collaboration) were found to be of importance to reach IACO implementation success in this sector.

One of the key barriers to implementation for this sector was a lack of financial resources. To our knowledge, this barrier was not previously cited as a barrier typical to the sector welfare- and sport. It has frequently been reported to impede IACO implementation in general[49,50,80,84-86]. Finding this barrier for the welfare and sports sector might be due to the large dependency of this sector on external (government-based) subsidies. The economic recession that occurred in the Netherlands during the time of our study[87] led to a significant decrease in governmental support. Especially subsidies that were not considered to promote so-called 'fundamental needs' (i.e. health care and education) were cancelled. As IACO project management did not provide financial support and welfare- and sport sector

activities were not considered 'fundamental' and thus not eligible for government support, this sector was hit hard by the financial recession. This sector might therefore have had more trouble to generate sufficient finances, explaining why this identified as a key barrier to IACO implementation for this sector. We should however emphasize that if subsidies are cut or withdrawn, IACO implementation can be jeopardized in all sectors that are dependent on this external financial support.

Unsolid collaboration was found to be a key impeding determinant to implementation only for welfare- and sports sector stakeholders. A quote from one of the welfare professional we interviewed reflects the opinion of the majority of professionals from this sector: *"I have the feeling that everyone is operating on their own little island, and are not willing or able to make a collective effort".* Previous studies have reported that unsolid collaboration can be due to a lack of shared professional repertoire; professionals embedded in diverse sectors often experience difficulties whilst collaborating because they struggle to comprehend the other sectors' goals and vocabulary[88]. A deepening of the relationships between IACO implementers from diverse sectors can potentially tackle these hurdles, facilitate communication and increase the power and magnitude of the collective effort[89]. However, if for example implementers are embedded in other sectors, the deepening of the relationship might take a considerable effort. It should then be closely monitored if the benefits of improving the relationship outweigh the effort and resources instated to establish this outcome.

Practical implications

- Jeffrey stated that insufficient financial resources were present to implement the IACO, as the welfare sector only has a limited budget to focus on a broad range of societal problems. Mutual adaptation could possibly have countered this problem, as the IACO activities could have been adapted and made less costly. **Joint problem ownership** between these stakeholders and project management might then have led to a more feasible IACO activity.
- Jeffrey expressed that collaboration with other stakeholders remained unsatisfactory. **Regular meetings** stakeholders from other sectors to evaluate IACO implementation with might better the collaboration between partners. Also, enabling stakeholders to investigate during these meetings what **they could gain from collaboration** and IACO implementation, and how they could accomplish these gains has been shown to optimize collaboration.
- According to Jeffrey, **high compatibility** between the goals of the IACO and the goals of the youth welfare organization was a key facilitator to implementation. This compatibility also gave rise to certain **advantages,** for example that some

organizational goals could be reached by implementing IACO activities. Enhancing or sustaining this level of compatibility seems key to sustain IACO implementation in this sector.

Private sector

Ellen, 38, manager supermarket (national chain)

I want to be a socially responsible entrepreneur! I do not solely want to make a profit but I also want help solve societal problems such as obesity. Also, the IACO activities I implemented granted me opportunities to meet new potential business partners and extent my clientele. So for me, it felt like a win-win situation. I however didn't always feel like we were 'in it together'. That we as community stakeholders made a collective effort to implement IACO activities. That lowered my implementation to implement the IACO. My supermarket also faced a high turnover of staff, and it was not possible to communicate to all our (part time) employees about how to implement IACO activities. So sometimes children came to our supermarket to get fruit free of charge, but didn't receive any because the employee was aware of the activity. And even so, not many children were interested in the 'fruit free of charge' activity. They'd rather buy candy or cookies using their own money.

In specific for the private sector, determinants related to 'intersectoral collaboration' and the 'community and context' were found to be of influence to IACO implementation.

The non-compliance of the target population was only identified as a key barrier to implementation for private sector stakeholders. Health care stakeholders named specific attributes of the target population (such as behavioural and financial problems) that impeded their uptake of the intervention, whereas private sector stakeholders only named that the target population did not attend their events or did not buy healthy foods without naming a cause of the non-compliance. Private sector stakeholders mentioned that the non-compliance of the target population led to a misbalance between their effort to implement the IACO and the benefits gained from implementation. A local supermarket for example started a campaign to promote fruit consumption and provided fruit for free to children, intending to target childhood obesity as well as attract new clientele. Very few children were however interested in the campaign and the supermarket was thus not attracting new clientele. In the end, the campaign was therefore halted due to a lack of response from the target population. This pitfall of lack of consumer response is widely cited as one of the major challenges of intersectoral obesity prevention[90].

We furthermore found that solid collaboration between community partners was a key facilitator solely for stakeholders embedded in this sector. This might be related to characteristics of the IACO activities prescribed to this sector. In contrast to the educational- and health care sector, most of the activities prescribed to private sector stakeholders required a high degree of intersectoral collaboration. On the other hand, the relative high importance of these determinants to the private sector could also be related to a major aim unique to this sector: namely 'making a profit'. Solid intersectoral collaboration, but also other key determinants identified for this sector such as a 'lack of shared commitment' and a 'lack of visibility of implementation efforts to other stakeholders', are all linked to in- or decrease of profit. Collaboration and shared commitment for instance creates opportunity to meet new potential business partners and to expand business. Moreover, observability of their implementation efforts provides opportunity to convey their 'high level of corporate social responsibility' which might attract potential clients. These conditions (solid collaboration, shared commitment, observability) can thus lead to potential external rewards (meet new business partners, extent clientele) that in turn can optimize their profit. This might explain why the presence or absence of these determinants is related to implementation success for this particular sector. Finally, feeling morally obligated to implement the IACO was identified as a key facilitator to the private sector. This could be due to the closing of the gap between private- and public enterprises; more and more private sector stakeholders voice a feeling of joint responsibility for societal issues[91]. However, although viewed as an essential component of current and future health promotion initiatives[91-93], tensions caused by for example conflict of interest within public-private partnership have been widely reported[94]. These partnership structures therefore need to be closely monitored, and transparency of expectations and goals of both the public and private partners is of great importance[94].

Practical implications

- IACO implementation makes Ellen feel like a **socially responsible entrepreneur,** which facilitates her implementation. Also, she named that **benefits gained** by implementing the IACO (new business partners, extending clientele) motivated her to implement. We would therefore advise to engage potential private partners by **together exploring both the personal and organizational benefits** to be gained. This insight into IACO implementation benefits could then potentially lead to more successful implementation efforts[9].
- Although Ellen felt that she had opportunities to meet new business partners, she did not feel like community stakeholders had a shared commitment towards IACO goals. Creating shared commitment between community stakeholders **through**

transparency and honesty[92] could be accomplished by creating a **group community identity**[95], for example by organizing IACO network meetings (starting with a kick-off meeting).

- Children were not always eager to participate in IACO activities. We argue that private partners should be informed prior to IACO implementation about the possible difficulties they could encounter when engaging children (and parents) in activities promoting a healthy lifestyle. We feel that thus that **expectation management,** in combination with **empowering of private partners** by for example indicating that their marketing skills could be useful when persuading children to buy into IACO activities, is key to successful IACO implementation.

Conclusion

The translation of an IACO into practice is a complex and dynamic process. Both the community context and, in turn, IACO program plans change frequently. This makes the implementation of IACOs more prone to error and deviation and implementation failure a genuine threat[96-101]. IACO process evaluation is not yet standardized. We encountered methodological difficulties when assessing IACO implementation degree and determinants. This underlines the need for IACO program management and the national EPODE bureaus to provide a detailed operationalization of (theory underpinning) the IACO activities and objectives they prescribe. This would also be a prerequisite for the planning of an adequate IACO process evaluation. However, to perform such a process evaluation, more 'research on how to perform IACO implementation research' is also needed. Based on the growing knowledge base and the results and instruments used in this study, not a golden standard but a 'golden toolkit' containing a broad spectrum of IACO process evaluations methods and measures should be established. Researchers, project managers and local stakeholders can then pick and adapt those methods and measures from the toolkit that are most salient to their setting and needs, allowing for a tailored and scientifically substantiated IACO process evaluation. Also, by enhancing uniformity in operationalization of terminology and measures, the 'golden toolkit' can potentially enhance the comparability of IACO process evaluation results. We furthermore found indications that different determinants influence IACO implementation success across sectors and over time. Thus to optimize implementation, we argue that an IACO implementation plan should not be formulated using a 'one size fits all' approach. Instead implementation plans should be tailored to the determinants identified per setting and sector, and should be adapted iteratively informed by the dynamics in local implementation experiences. Preferably, we argue that community based action research[5] based on a mutual adaptation strategy[45] should be instated to account for feedback on how change is progressing over time. These strategies enable IACO

program management, local community stakeholders and researchers to jointly evaluate and making informed decisions about the need for and how-to adapt implementation plans.

Advise for future research initiatives

We used mixed-method research to elucidate which determinants influenced the IACO process. This allowed us to gain both an in depth and broad understanding of the determinants that lead to IACO implementation success or failure. Although quantitative analysis was possible in our study, the number of cases we could include was limited and results of this analysis should therefore be interpreted and extrapolated with caution. We advise future researchers to upscale the quantitative part of their research and include more IACO implementers from a larger number of communities, for example by collaborating more closely with the EPODE national bureau. Our study is one of the first to follow IACO implementation at the community level over time, which provides us with very useful insight into how determinants differ over time and across sectors.. We were however unable to follow IACO implementation efforts of the same stakeholders longitudinally, as a number of stakeholders declined participation after the first measurement due to research fatigue[102]. A high turnover of staff and frequent policy changes were also opposing the longitudinal study of IACO implementation. We consider these congruent to IACO implementation and maybe even inevitable because of the dynamics and ever-changing character of IACO implementation. Nevertheless, it would be interesting to verify if our finding that IACO implementation determinants differ over time and for sectors is also true when following the same stakeholder at multiple points in time. Moreover, although not all factors opposing longitudinal research within IACO implementation are changeable, perhaps research fatigue could be countered. Making sure participants are not approached by different research teams with similar research questions, providing participants with feedback on the results, but also ensuring that research participation leads to visible changes or personal advantages might reduce research fatigue[103].

We furthermore used purposeful sampling[104] to select study participants. Taken into account local opportunities, we feel that this sampling method was most suitable to obtain a representative sample, but it still might have caused some form of selection bias[105,106]. Stakeholders that declined (further) participation often stated they suffered from research fatigue[102] or time constraints. Hence, it might be that participants who did agree to participate were more motivated to implement their IACO (and thus to participate in our study) or felt less strained by their workload. As random sampling within implementation studies is difficult, it might be advisable to use a multi-stage purposeful sampling strategy. This strategy is combines iterative (re)sampling focused on the creation of variation (stratified purposeful) and similarities (criterion-i sampling) amongst included implementers[104]. In

this way, selection bias can be countered and optimize internal and external validity. We used Social Network Analysis (SNA) to explore the impact of network development on IACO implementation. Studies on network development in communities implementing intersectoral approaches are sparse[107,108], and to our knowledge we were the first to address network development in communities implementing an IACO. Intersectoral collaboration is one of the key features of an IACO, and we feel that incorporating network analysis into an IACO process evaluation is therefore necessary to truly understand its implementation process. Network analysis is however a complex technique not commonly practiced by health promotion researchers. To adequately apply SNA, an in depth understanding of its core principles and analysis (software) is warranted. We therefore urges future researchers to develop an easy-to-use version of SNA, which can also be used by for instance statistically educated epidemiologists working at the local municipal health services. This would in our opinion be a way to increase the uptake of SNA in IACO process evaluations guided by researchers who do not have the time, resources or knowledge to take up SNA in its current form. In time, this might lead to a better understanding of network development (and its relationship with implementation degree). SNA can also be used to support action research, by for example evaluating network development with community stakeholders using the SNA results. This form of evaluation might then improve collaboration and strengthen network development.

Finally, we would like to suggest some future research pathways. We found that determinants of IACO implementation differed per sector and overtime and that sometimes determinants in interaction seemed to influence implementation success. We however do not yet know if these determinants can be translated into effective implementation strategies.. It is moreover still debated if multi-faceted or single implementation strategies should be formulated to adequately address these (interacting) determinants[29,30]. Research testing implementation strategies targeting the (interacting) determinants identified in this thesis would in our opinion be the next step forward. Summarizing, we therefore advise future studies to further refine if and which (interacting) determinants influence IACO implementation over time and across sectors, how these determinants can then be translated translation into effective IACO implementation strategies, and whether it matters if multi-faceted or single strategies are used. The process of translation of determinants into strategies could be guided by the 'theory informed behavior change' method to implement change as proposed by French *et al.*[109]. This promising method allows for the systematic linkage between pathways of change ((interacting) determinants) to behavior change techniques and their translation to feasible implementation strategies and plans.

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Summary

9

Summary

Background

Childhood obesity remains an urgent public health problem. The prevalence of obesity in children is still alarmingly high, and both the psychosocial and medical consequences of childhood obesity are severe. **Chapter 1** elaborates on the issue of childhood obesity, and the quest to find a preventative intervention that can successfully halt the childhood obesity epidemic. It describes the success of the French EPODE approach in reducing childhood obesity, and the subsequent development of several EPODE-derived Intersectoral community Approaches targeting Childhood Obesity (IACOs). Although theoretically promising, the translation of IACOs into practice is often arduous and implementation failure is frequently reported. The aim of this thesis was therefore to evaluate the implementation of five EPODE-derived IACO's in the Netherlands and elucidate critical determinants for implementation success. The process evaluation framework for complex interventions is introduced and the use of this framework in our study is detailed. The framework for determinants of innovation (Fleuren *et al.*), which categorizes implementation determinants into five distinct categories (innovation, innovation strategies, provider, organization, community & context) is also described.

Research Consortium

This study is part of the research Consortium Integrated Approach of Overweight (CIAO). CIAO is a concerted action of Academic Collaborative Centres, local academic institutions, regional public health services and relevant local authorities. **Chapter 2** describes the research aims, concepts and methods used within CIAO, which are based upon prior research revealing lacunas in knowledge of and skills related to five elements of EPODE-derived IACOs; namely political support, parental education, implementation, social marketing and evaluation. The overall consortium aim of CIAO to gain theoretical and practical insight of these elements through five sub-studies is discussed. The output of CIAO will consist of a blueprint the development and evaluation of IACOs, which can potentially support communities to further optimize the implementation and subsequently the effects of this approach.

Systematic literature review

As mentioned in the first chapter, the implementation of an IACO contains many hurdles and is therefore considered challenging. To start our study and help overcome these challenges, we first needed an overview of the evidence to date. **Chapter 3** describes a systematic literature review on the outcome indicators and determinants of implementation success or failure of IACOs. Four databases were searched resulting in the inclusion of 25 studies. Study

quality of each of these studies was then appraised using the Crowe Critical Appraisal Tool (for quantitative research) and the Quality Framework (for qualitative research). All reported implementation outcome indicators and determinants were reviewed via narrative synthesis. Appraisal revealed that the quality of included was on average moderate to low. Fidelity and coverage were the most frequently reported indicators of implementation success, the association between determinants and implementation indicators was however never explicated. The determinants of IACO implementation identified via narrative synthesis were mostly related to the social-political context and the organization. The eterminants 'collaboration between community partners', 'the availability of (human) resources' and 'time available for implementation' received the highest star score. Our review furthermore revealed

that the research field on IACO implementation is still in its infancy. More research on the process of implementing IACOs is needed to (dis)confirm findings, and emphasis should be placed on the elucidation of the relationship between determinants and implementation indicators. Our review also revealed that a 'golden standard' for evaluating and reporting on implementation research is lacking. If such a standard was to be developed, this could improve the comparison of study outcomes and may constitute the cumulative development of knowledge about the conditions for designing evidence-based implementation strategies.

Evaluation of IACO implementation

Chapter 4 presents the result of a case study performed on a community implementing the EPODE-derived Youth At a Healthy Weight (JOGG) approach. This community translated the JOGG approach into a water and fruit campaign targeting children ages 0-12 years. Implement degree (completeness) and determinants of campaign implementation were evaluated longitudinally in five half yearly research waves. Semi-structured observations, interviews, field notes and professionals' logs entries were used to collect the relevant data, which were then analysed using a framework approach. Both within-case and cross-case displays were formulated and subsequently, key determinants identified. Principles from Qualitative Comparative Analysis (QCA) were used to identify causal configurations of determinants. Results showed that implementation completeness differed across professionals, but was highest in the educational and health care sector. The determinants and causal configurations of determinants identified were mostly sector- and implementation phase specific, but key barriers identified varied more than key facilitators. High ownership for campaign goals and high compatibility of the campaign with existing procedures were most often cited as facilitators, whereas a lack of reinforcement strategies, a low priority for campaign use, low procedural clarity and incompleteness of campaign materials were most frequently indicated as barriers. Eleven causal configurations of determinants were identified across sectors and a majority of configurations was related to medium or high

levels of completeness. We argue that these results indicate we should perform multiple 'stitches in time'; tailoring implementation strategies to specific implementation phases and sectors using both the results from this study and a mutual adaptation strategy in which professionals are involved in the development of implementation strategies.

As described in our systematic review, IACO implementation has mostly been assessed using qualitative methods and the relationship between implementation degree and determinants of IACO implementation had never quantified. To bridge this gap, we assessed the relation between implementation degree and determinants of implementation quantitatively using the MIDI questionnaire. **Chapter 5** provides an overview of this study and its results. Professionals implementing an EPODE-derived IACO in five communities in the Netherlands were purposefully sampled, and implementation was evaluated via an adapted version of the MIDI questionnaire. A three-step hierarchical multivariate linear regression revealed that 65% of the variance in implementation adherence was predicted by our model. Higher levels of self-efficacy, being an implementer embedded in community B, and having more than one year of experience with IACO implementation were associated with higher degrees of adherence, whereas formal ratification and a high number of prescribed IACO activities were related to lower degrees of adherence. We argue that if IACO implementation strategies and plans are designed, particular attention herein should be paid to the enhancement of professionals' self-efficacy, the number of activities prescribed and allocation of sufficient time for professionals to get acquainted with IACO implementation.

In **Chapter 6**, we report on our longitudinal study on the implementation of five EPODE-derived IACOs in the Netherlands. Aim was to unravel which determinants influenced IACO implementation and if differences across communities, sectors and in time were present. To this end, we held semi-structured interviews with 189 community stakeholders implementing an IACO in one of these communities. Twenty-two key determinants of implementation were identified. Key facilitators identified were mostly internal (stakeholder level), whereas the key barriers identified were mostly external (at the level organization or community context level). We furthermore found that the key determinants identified varied significantly across sectors and in time. There was especially a striking contrast between the key determinants identified for on the one hand the educational & health care sector and on the other hand the private, welfare & sports sector. Only 'perceived importance of IACO goals' was identified as an implementation facilitator across sectors, communities and in time. One other important finding is that stakeholders expressed they needed possibilities to adapt the approach in order to optimize compatibility with their local setting. In conlusion, results of this study undeline the need for tailored implementation plan per sector and in time, preferably using a 'mutual adoption strategy'. Via mutual adaption, community

stakeholders and local IACO project managers can jointly optimize implementation efforts by formulating implementation strategies based on scientific evidence and local best practices. Strategies should then be amended iteratively, to ensure the implementation plans remain salient with the local context.

Network development & IACO implementation

An IACO can be considered as a 'whole system approach', in which stakeholders from different levels of the community of the child are mobilized to help establish a non-obesogenic environment. It is however not yet clear how intersectoral collaboration between stakeholder, and in turn, network development is associated with IACO implementation success. We therefore used Social Network Analysis (SNA) to examine how obesity prevention networks developed over time within three communities implementing an IACO in the Netherlands. We also evaluated if and to which extent network development was related to implementation degree. **Chapter 7** describes this study and its results. With regard to implementation degree, our results showed varying degrees across communities. Implementation degree was highest for the domain 'local organization' and lowest for the domain 'linkage between preventative and curative care'. As for network parameters; network size differed across communities and was largest in community A and lower in communities B&C. Project management was identified as the most influential and prominent actor in all communities. We also found indication for a an association between a well balanced distribution of actors per sector and a higher degree of IACO implementation. Indication for a negative associations with implementation degree were found for a high level of collaboration, a large network size, a less centralized network and a decrease in centralization over time Overall, we found that a change in network parameters over time might be more strongly associated with implementation degree than the assessment of these parameters at one single point in time. Results of this study provide leads for the formulation of network development strategies that could potentially optimize IACO implementation. More research is needed to further explore and test these leads and potential strategies in practice, to refine EPODE program objectives with regard to network development and ultimately improve IACO implementation.

General discussion and implications of findings

Chapter 8 discusses and compares the findings of the studies presented in this dissertation, compares these findings to the previous literature and discusses methodological issues. It also provides practical implications derived from our study findings for practice as well as research. Finally, it highlights paths for future research.

Nederlandse samenvatting

De alarmerend hoge prevalentie van overgewicht bij kinderen vormt een grote bedreiging voor de volksgezondheid. **Hoofdstuk 1** beschrijft de etiologie en gevolgen van overgewicht bij kinderen, en illustreert de zoektocht naar een adequate interventie om overgewicht bij kinderen te reduceren of voorkomen. De Franse intersectorale community aanpak 'EPODE' is een van de weinig interventies die veel belovende resultaten heeft laten zien. Het percentage van kinderen met overgewicht in EPODE gemeenten bleek na tien jaar significant lager te zijn dan in vergelijkbare, omliggende gemeenten (8.8% vs. 17.8%). Hoofdstuk 1 beschrijft hoe dit succes heeft geleid tot de wereldwijde disseminatie van op EPODE gebaseerde, Intersectorale Community Aanpakken ter preventie van Overgewicht bij kinderen (IACOs). Ook wordt in dit hoofdstuk beschreven dat er specifiek voor dit soort complexe aanpakken sprake is van een 'translationale kloof'; de implementatie van deze aanpakken wijkt in de praktijk vaak af van de aanpak zoals bedoeld. Het doel van dit proefschrift is dan ook om de implementatie van vijf op EPODE gebaseerde IACOs in Nederland te evalueren, en te onderzoeken welke determinanten zorgen voor het falen of slagen van implementatie.

Deze studie maakt deel uit van het Consortium Integrale Aanpak Overgewicht bij kinderen (CIAO). CIAO is een samenwerkingsverband tussen vijf Academische Werkplaatsen, lokale academische instellingen, regionale gemeentelijke gezondheidszorg diensten (GGDs) en diverse lokale partners. **Hoofdstuk 2** beschrijft de onderzoeksdoelstellingen en methodieken gebruikt in alle vijf deelstudies behorend bij CIAO. Deze deelstudies komen voort uit eerder onderzoek vanuit CIAO welke kennis- en vaardigheidslacunes aantoonde binnen vijf elementen van de IACO; politiek-bestuurlijk draagvlak, ouderbetrokkenheid, implementatie, sociale marketing en de formatieve evaluatie van de IACO. De resultaten van CIAO zullen bijdragen aan een blauwdruk voor de ontwikkeling, uitvoering en evaluatie van toekomstige IACOs. Deze blauwdruk kan gemeenten ondersteunen bij het opzetten, implementeren en evalueren van een IACO ten einde de effecten van de aanpak verder te optimaliseren.

Hoofdstuk 3 beschrijft de door ons uitgevoerde systematische literatuurstudie naar indicatoren en determinanten van de implementatie van IACOs. Vier databases als mede de grijze literatuur werden systematisch onderzocht, wat resulteerde in de inclusie van 25 studies. Studie kwaliteit werd beoordeeld met behulp van de Crowe Criticial Appraisal Tool (voor kwantitatief onderzoek) en het Quality Framework (kwalitatief onderzoek). Indicatoren en determinanten van IACO implementatie werden geïdentificeerd met behulp van narratieve synthese. De kwaliteit van de geïncludeerde studies varieerde, maar was over het algemeen 'matig tot gemiddeld'. Uit onze review bleek dat 'fidelity' en 'coverage' het vaakst werden gebruikt als indicator voor de mate van implementatie; en dat de associatie

tussen determinanten en indicatoren van implementatie niet werd gekwantificeerd. De geïdentificeerde determinanten van IACO implementatie waren het meest verwant aan de sociaal-politieke context en de organisatie. De determinanten met de hoogste 'evidence index' waren: 'samenwerking tussen de partners in de community', 'de beschikbaarheid van mankracht en middelen' en 'tijd beschikbaar voor implementatie'. Uit onze review blijkt dat slechts in beperkte mate zicht is op de determinanten die essentieel zijn voor de implementatie van IACOs. Meer onderzoek naar het implementatie proces van IACOs is nodig om de resultaten van deze review te verifiëren, en de relatie tussen determinanten en indicatoren van implementatie te verhelderen. Er is verder nog geen 'gouden standaard' ontwikkeld voor het evalueren en rapporteren van het IACO implementatieproces. De ontwikkeling van een dergelijke standaard zou de kwaliteit en vergelijkbaarheid van studies kunnen verbeteren, en daarmee de kennis over de voorwaarden voor het ontwerpen van IACO implementatie plannen en strategieën kunnen vergroten.

In **hoofdstuk 4** wordt een case studie beschreven naar de implementatie van de op EPODE gebaseerde IACO Jongeren Op Gezond Gewicht (JOGG) in een grote gemeente in Nederland. De JOGG-aanpak in deze gemeente bestond uit een water- en fruit campagne gericht op kinderen tussen de 0-12 jaar. De mate waarin de campagne werd geïmplementeerd zoals bedoeld door de ontwikkelaars (compleetheid) en de determinanten van implementatie werden longitudinaal geëvalueerd middels vijf halfjaarlijkse meetmomenten. Semigestructureerde observaties, interviews en veldnotities werden gebruikt om onze onderzoeksvragen te beantwoorden. Data werd geanalyseerd met behulp van een 'framework approach', waarbij within-case en cross-case tabellen werden gemaakt om de belangrijkste determinanten van implementatie te identificeren. Qualitative Comparative Analysis (QCA) werd ingezet om causale configuraties van determinanten per sector en in de tijd te identificeren. De mate van implementatie was het hoogst voor professionals werkzaam in de onderwijs- en zorgsector. De kernactiviteiten werden vaker volledig geïmplementeerd dan de zogenoemde 'additionele' activiteiten. Een groot gevoel van eigenaarschap voor de doelen van de campagne en een hoge compatibiliteit van de campagne met de bestaande procedures werden het vaakst genoemd als bevorderende determinanten, terwijl een gebrek aan nieuwe impulsen voor implementatie, een lage prioriteit voor implementatie, lage procedurele helderheid van de campagne instructies en onvolledigheid van de campagne materialen het vaakst werden aangeduid als belemmerende determinanten. Elf causale configuraties werden geïdentificeerd; een meerderheid was gerelateerd aan een gemiddelde of hoge mate van implementatie. De geïdentificeerde determinanten en causale configuraties van determinanten waren voor het grootste deel sector- en tijd specifiek. Daarom concluderen wij dat 'stitches in time' nodig zijn om IACO implementatie goed te laten verlopen; We verwachten dat het implementatie proces bevorderd kan worden als implementatie

strategieën iteratief herzien en aangepast worden voor specifieke implementatiefasen en sectoren. Voor deze afstemming adviseren wij gebruik te maken van 'mutual adaptation'; een strategie waarbij lokale stakeholders, managers en onderzoekers gezamenlijk gevraagd wordt implementatie plannen en strategieën te verifiëren en zo nodig aan te passen.

Uit onze systematische review bleek dat IACO implementatie meestal wordt onderzocht met behulp van kwalitatieve methoden, en dat de relatie tussen de mate van implementatie en determinanten van implementatie nog nooit kwantitatief onderzocht was. Daarom voerden wij een kwantitatieve studie uit naar de relatie tussen de mate van IACO implementatie en determinanten van implementatie **(Hoofdstuk 5).** Professionals uit vijf wijken in Nederland die een op EPODE gebaseerde IACO implementeerden werden middels een doelgerichte steekproef geselecteerd. Het implementatieproces werd vervolgens geëvalueerd via een aangepaste versie van de MeetInstrument voor Determinanten van Innovaties (MIDI). Het hiërarchische multivariate lineaire regressie model verklaarde 65% van de variantie in de mate van implementatie. Een hogere mate van self-efficacy, een implementeerder zijn in wijk B, en het hebben van meer dan een jaar ervaring met IACO implementatie waren geassocieerd met een hogere mate van implementatie. Formele bekrachtiging van de implementatie en het voorschreven krijgen van een hoger aantal IACO activiteiten per professional was gerelateerd aan een lagere mate van implementatie. We adviseren om bij het ontwerpen van een IACO implementatie plan strategieën te includeren gericht op het verhogen van de professionals' self-efficacy, het beperken van het aantal voorgeschreven IACO activiteiten per professional, en het uittrekken van voldoende tijd voor implementatie (meer dan 12 maanden). We achten nieuwe, longitudinale studies nodig om de gevonden bevindingen te verifiëren en de MIDI verder te ontwikkelen voor toepassing binnen IACO implementatie.

Hoofdstuk 6 beschrijft de longitudinale studie naar de implementatie van EPODE-gebaseerde IACOs in vijf wijken in Nederland. Doel van deze studie was om te onderzoeken welke determinanten van invloed zijn op IACO implementatie en of er verschillen konden worden gevonden in de tijd, tussen de wijken en tussen sectoren. Binnen de vijf wijken hielden we 189 semigestructureerde interviews met professionals die IACO activiteiten implementeerden. Na analyse werden 22 kerndeterminanten van implementatie gevonden. De bevorderende kerndeterminanten waren meestal intern (niveau van de professional), terwijl de belemmerende kerndeterminanten vooral extern waren (op het niveau van de organisatie of context van de wijk). Bovendien werden er grote verschillen gevonden in zogenaamde 'kerndeterminanten' per sector en in de tijd. Het contrast tussen vooral de kerndeterminanten van implementatie voor de onderwijs- en gezondheidszorg sector en kerndeterminanten geïdentificeerd voor de private-, welzijns- en sport sector was groot. Alleen 'het door de professional toegekende belang aan de doelen van IACO'

werd geïdentificeerd als kerndeterminant voor alle sectoren en wijken door de tijd heen. Een andere essentiële bevinding van ons onderzoek was dat professionals het belangrijk vonden om de mogelijkheid te hebben de IACO activiteiten aan te passen aan hun eigen wensen. Ook bleek implementatie succes gerelateerd aan een goede aansluiting tussen de IACO activiteiten en de overige werkzaamheden van de professional. Concluderend achten wij daarom de noodzaak van 'op maat gesneden' implementatieplannen en strategieën per sector en in de tijd groot. Resultaten uit deze studie bevestigen ook de bevindingen uit hoofdstuk 4; namelijk dat implementatie strategieën bij voorkeur ontworpen moeten worden met behulp van een 'mutual adoption' aanpak. Via deze aanpak kunnen professionals, onderzoekers en projectmanagers gezamenlijk input kunnen leveren voor implementatieplannen, op basis van wetenschappelijk bewijs en lokale 'best practices'. Strategieën moeten vervolgens iteratief worden herzien en aangepast, om ervoor te zorgen de plannen saillant blijven aan de lokale context.

Het is nog onduidelijk of en hoe intersectorale samenwerking en de ontwikkeling van een obesitas preventie netwerk gerelateerd zijn aan de mate van IACO implementatie. Met behulp van Sociale Netwerk Analyse (SNA) onderzochten wij daarom de ontwikkeling van netwerken omtrent obesitas preventie bij kinderen in drie verschillende wijken die de IACO JOGG implementeerden. Ook evalueerden wij of en in hoeverre de ontwikkeling van het netwerk en specifieke netwerkkenmerken gerelateerd waren aan de mate van implementatie. **Hoofdstuk 7** beschrijft de resultaten van dit onderzoek. De mate van implementatie verschilde per wijk en per categorie van doelstellingen. Verder varieerde de grootte van het netwerk en het aantal connecties gemaakt tussen netwerk actoren in de tijd en per wijk, De IACO project manager was de meest invloedrijke en prominente network actor binnen alle wijken, behalve in wijk C op T1. Een gebalanceerde verdeling van netwerk actoren per sector ijkt verder geassocieerd met een hogere mate van implementatie, terwijl een hoge mate van samenwerking, een gedecentraliseerd netwerk, een netwerk met relatief veel partners, en een daling van netwerkcentralisatie in de tijd geassocieerd lijken met een lagere implementatie op netwerkniveau. Deze longitudinale studie biedt belangrijke informatie over de mogelijke relatie tussen de mate van IACO implementatie en netwerkontwikkeling en kenmerken. Onze studie resultaten bieden verder een ingang om netwerk ontwikkelingsstrategieën te formuleren die mogelijk IACO implementatie kunnen verbeteren. Deze strategieën moeten in vivo getest en geëvalueerd worden om hun relatie met IACO implementatiegraad verder te valideren.

In **Hoofdstuk 8** worden de resultaten van de studies beschreven in dit proefschrift beschouwd vergeleken, en geduid. Methodologische vraagstukken voortkomend uit deze studies worden besproken, evenals praktische implicaties van dit proefschrift voor praktijk en onderzoek. Tot slot worden wegen verkent voor toekomstig onderzoek naar de implementatie van IACOs.

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Curriculum vitae

Rianne van der Kleij was born on the 30th of June 1985 in Groningen. After finishing her secondary school (athenaeum) in 2003, she studied Psychology and Medicine at Leiden University, the Netherlands. She also followed elective courses at the Leiden University Faculty of Arts and the Royal Conservatory of the Hague. She obtained her master's degree in Health Psychology in 2011. During her studies, she participated in several committees at her fraternity (LVVS Augustinus) and the Psychology Students Association Labyrint. Furthermore, she was a board member of the Psychology Students Association Labyrint and president of the foundation for educational materials (2004-2005). She also participated as a student member of both the Psychology and Medicine educational advisory board.

In 2011, she started her PhD research at the department of Public Health and Primary Care at the Leiden University Medical Centre. Her PhD was part of the Consortium Integrated Approach to childhood Obesity (CIAO) and focussed on the implementation of intersectoral community approaches targeting childhood obesity. Her research was supervised by Prof. dr. Ria Reis, Dr. Matty Crone and Dr. Theo Paulussen. At the moment, Rianne is working as a senior researcher on several research projects covering non-communicable lung disease, palliative care, prevention of unhealthy behaviour and e-health applications. Furthermore, she is the project manager of the Horizon 2020 project FRESH AIR and is employed as a psychologist-coach for the GP vocational training.

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- **Van der Kleij RMJJ**, Coster N, Verbiest M, Assema P, Paulussen T, Reis R, Crone M. Implementation of intersectoral community approaches targeting childhood obesity: a systematic review. Obesity Reviews. 2015 16(6):454-72
- van Koperen MT, **van der Kleij RMJJ**, Renders CC, Crone MM, Hendriks AM, Jansen MM, van de Gaar VV, Raat HJ, Ruiter EE, Molleman GG, Schuit JA. Design of CIAO, a research program to support the development of an integrated approach to prevent overweight and obesity in the Netherlands. BMC obesity. 2014 Feb 19;1(1):1.

Papers submitted

- **van der Kleij RMJJ**, Crone M, Reis R, Paulussen T. How does network development relate to implementation success of intersectoral community approaches targeting childhood obesity? An exploratory social network analysis. Submitted.

Presentations at (inter)national conferences)

- Werk op tijd maakt wel bereid? De implementatie van een JOGG aanpak in een grote gemeente in Nederland. Nederlands Congres Volkgsezondheid 2015, Utrecht, the Netherlands *(oral presentation)*.
- "Wat weten we nu over de implementatie van een integrale aanpak, zoals JOGG (Jongeren op Gezond Gewicht)?" Symposium JOGG 2015, Utrecht, the Netherlands *(oral presentation)*.
- Using Social Network Analysis To Assess The Development Of Community Partnership Networks Within EPODE-derived, Integrated Approaches Targeting Childhood Overweight Obesity Reviews, Volume 15, Issue Supplement S2, Pages 206-248. International Confernce on Obesity (ICO) 2014, Kuala Lumpur, Malaysia (*oral presentation)*.
- Implementing the 'water- and fruit campaign': A process evaluation of the integrated community approach Youth At a Healthy Weight (JOGG) in the Netherlands ISBNPA 2013, Ghent, Belgium *(oral presentation)*.
- The implementation of a multi-faceted, integrated approach to prevent overweight in children: A case study. Holland Fuse congres, Noordwijk, the Netherlands (*oral presentation)*.
- The diffusion of a comprehensive integrated community approach to prevent overweight and obesity in children in the Netherlands: a study protocol. Obesity facts, Vol. 5, Suppl. 1, 2012. European Congres on Obesity (ECO) 2012, Lyon, France *(poster presentation)*

Overview of graduate training activities & courses

- PhD introductory course, 2011 *(Graduate School LUMC, Leiden, the Netherlands)*
- Communication in Science, 2011 *(Graduate School LUMC, Leiden, the Netherlands)*
- Advanced academic writing, 2011 *(Graduate School LUMC, Leiden, the Netherlands)*
- Implementation Science Summer School 2012 *(Trinity College, Dublin, Ireland)*
- Performing focus groups, 2012 *(Evers Research, The Hague, the Netherlands)*
- Qualitative Research & Interviewing, 2012 *(University of Amsterdam, Amsterdam, The Netherlands)*
- Qualitative Methodology & Data Analysis, 2012 *(Graduate school faculty of Social Sciences, Leiden, the Netherlands)*
- Graduate students' internship: supervising & grading, 2013 *(Leiden University Medical Center, Leiden, the Netherlands)*
- Qualitative Comparative Analysis: Comparative Configurational Approaches, 2013 *(NGI Skill course, Utrecht, the Netherlands)*

- Development of (university level) education programs, 2014 *(Leiden University Medical Center, Leiden, the Netherlands)*
- Testing students: creating (university level) exams, 2014 *(Leiden University Medical Center, Leiden, the Netherlands)*
- Network Analysis, 2014 *(NGI Skill course, Utrecht, the Netherlands)*
- BROK course, 2015 *(Graduate School LUMC, Leiden, the Netherlands)*
- Subsidie aanvragen schrijven, 2015 *(ZonMw, The Hague, the Netherlands)*