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The implementation of intersectoral community approaches targeting childhood obesity

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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'Obésité 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).

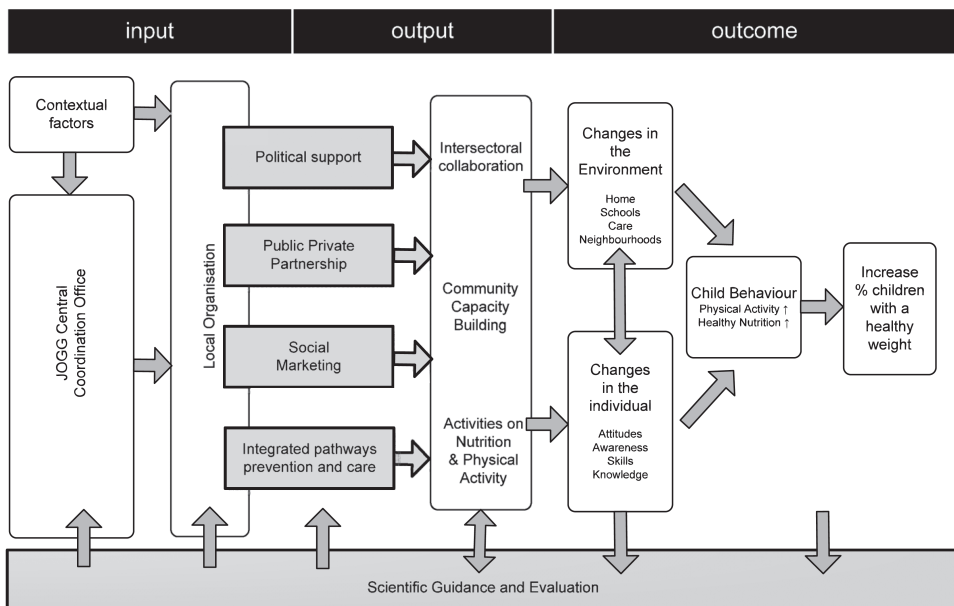


Figure 1. EPODE program methodology, van Koperen *et al.* (10)

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 Carroll *et al* (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 (<i>occupation</i>), 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.	
Organisation	e) Matching goals	●	The goals of the IACO match my own goals as a (<i>occupation</i>).	
	5. Personal benefits	●	Using the IACO provides me personally with more advantages than 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?	
	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.
	13. Innovation strategies				
	a) Instruction		•		Before the start of the IACO, I have been provided with clear instructions on how to use the IACO.
Innovation strategies	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 MID; 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	Mostly PA	Combination nutrition/ PA	Combination nutrition/ PA
Number of PPPs	>5	<5	>5	<5	<5

^aAll 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: <i>installment of fruit & water moments, informing parents about N.</i>	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: <i>motivating youth in medical consultations to increase fruit/water intake, advising parents</i>	Nutrition decision making/‘resilience’ program	Children’s physical therapy ‘toddler gym’	Children’s physical therapy ‘toddler gym’	-
Welfare & sports	Fruit and water campaign <i>Integrating healthy PA & N into existing activities, gadgets distribution</i>	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 <i>Providing fruit and water free of charge, sponsoring of activities</i>	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).

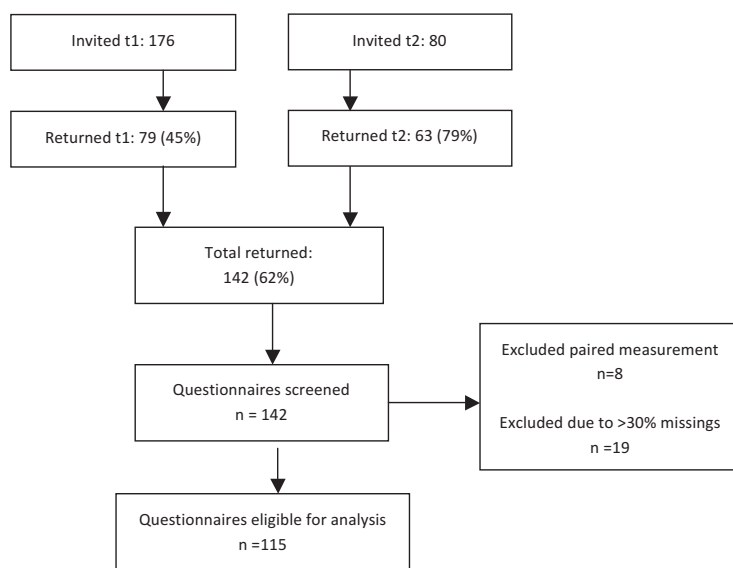


Figure 2. Participant flow chart

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			Block 1			Block 2			Block 3		
			β	CI 95%	β	CI 95%	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	-0.16, 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 implemented 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						
F for change in R ²						10.08**		6.45**						
												.65		12.32**

α Chronbach's alpha. * $p < 0.05$, ** $p < 0.01$, *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 and 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 indicate 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 perception 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 than 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 protocolled (38), whereas IACOs often follow a combination of a top-down and bottom-up approaches and are less protocolled. A highly protocolled 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 protocolled 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 assess 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 intend 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 extent adaptations

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 assess this broader variety of process indicators, if resources are available. This study also provides leads for policy makers. By combining 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 strengthen 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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