The implementation of intersectoral community approaches targeting childhood obesity

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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.

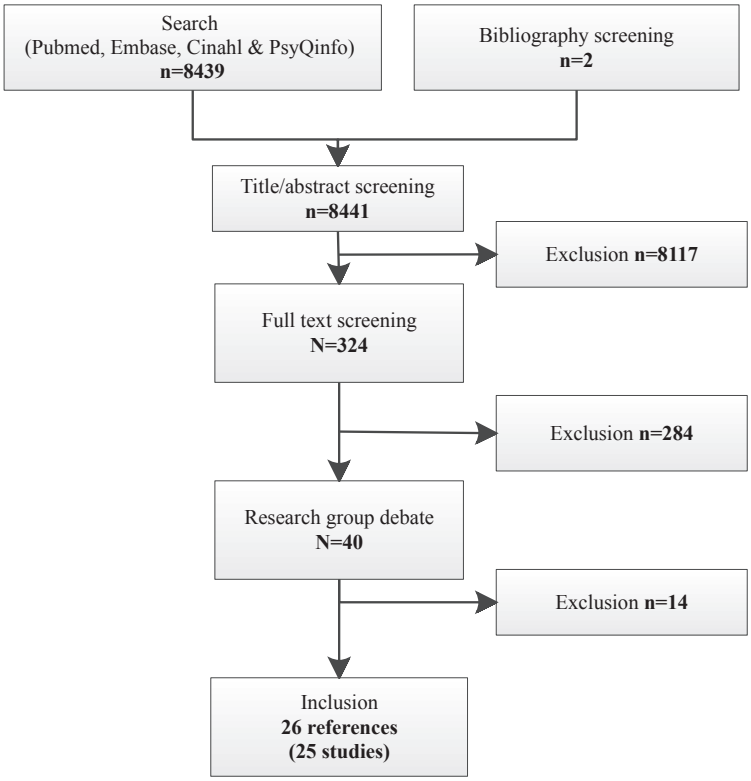

Figure 1. Process of inclusion

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				Direction of influence		
		⋆ (n=4)	⋆⋆ (n=9)	⋆ ⋆⋆ (n=4)	⋆⋆ ⋆⋆ (n=5)	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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