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Motivational Interviewing for Parent-child Health Interventions: A Systematic Review and Meta-Analysis

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Motivational Interviewing for Parent-child Health Interventions: A Systematic Review and Meta-Analysis

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Abstract: *Purpose: Motivational interviewing (MI) is a patient-centered approach focusing on building intrinsic motivation for change. This paper presents a meta-analysis of parent-involved MI to improve pediatric health behavior and health outcomes.* **Methods:** *Study inclusion criteria: (1) examined modifiable pediatric health behaviors (< 18 years old); (2) used MI or motivational enhancement; (3) conducted a randomized controlled trial with a comparison group (non-MI control or active treatment group); (4) conducted the intervention with only a parent or both a parent and child; and (5) were written in English. Twenty-five studies (with 5,130 participants) were included and independently rated. Weighted mean effect sizes, using random-effects assumptions, were calculated.* **Results:** *Relative to comparison groups, MI was associated with significant improvements in health behaviors (e.g., oral health, diet, physical activity, reduced screen time, smoking cessation, reduced second hand smoke) and reduction in body mass index. Results suggest that MI may also outperform comparison groups in terms of dental caries, but more studies are needed. MI interventions were more successful at improving diets for Caucasians and when the intervention included more MI components.* **Conclusions:** *Our findings provide support for providing motivational interviewing to parents and children to improve pediatric health behaviors.* (Pediatr Dent 2015;37(3):254-65)   Received January 22, 2015 | Last Revision April 1, 2015 | Accepted April 10, 2015

KEYWORDS: MOTIVATIONAL INTERVIEWING, META-ANALYSIS, ORAL HEALTH, PEDIATRICS, HEALTH BEHAVIORS

Motivational interviewing (**MI**) is a patient-centered treatment that focuses on building intrinsic motivation for change by exploring and resolving ambivalence.[1] MI is patient centered in that the provider attempts to understand the patient's expectations, beliefs, perspectives, and concerns about changing their health behaviors. Counseling techniques are calibrated to the patient's level of readiness to change, with educational approaches given only when the patient is ready and willing to hear the information, and provided in a collaborative, autonomy-promoting manner. Providing education to patients who are ambivalent about change has paradoxical effects, producing resistance to change.[2-4] MI is directive in that the conversation is structured to produce movement toward change. A comfortable and non-judgmental atmosphere is created that allows the patient to talk about the pros and cons of changing, without coercion to change or premature suggestions of change options. The core of MI involves strengthening intrinsic motivation by discussing how change is consistent with the patient's own values and goals.[5] Patients are given the autonomy to make their own decisions about change, which has been shown to increase commitment to change.[3]

MI was first developed by William Miller in 1983 for the treatment of alcoholism; it was later expanded by Miller and Rollnick[1] to target a variety of mental health and physical conditions.[1,6] MI has been successfully used to promote healthy behaviors, such as exercise,[7] glycemic control,[8] oral health,[9,10]

medication adherence,[11,12] and weight loss,[13] as well as reduce maladaptive behaviors such as smoking,[14,15] sexual risk behaviors,[16] and gambling.[17] Meta-analyses have shown that MI significantly outperforms controls (no treatment and waitlist), and treatments based on education, across a wide variety of health behaviors, including exercise, diet, weight loss, oral health, smoking, substance abuse, and safe-sex behaviors[15,18-21] One meta-analysis has shown that MI outperforms traditional advice-giving in approximately 80 percent of studies, with significant effects for body mass index (**BMI**), blood cholesterol, systolic blood pressure, and blood alcohol concentration.[22] If MI is used as a stand-alone treatment, positive effects are seen early and tend to diminish across a year of follow-up; however, when MI is used in conjunction with other treatments, the effect of MI is maintained or increased over time.[20]

Meta-analyses of the effect of MI on adolescent and young adult health behaviors have shown weaker effects for risky behaviors (e.g., alcohol use and abuse[23]) but more positive effects for health-promoting behaviors (e.g., weight, diet, sleep, and physical activity[24,25]). For example, in their meta-analysis of the effect of MI on eight different health promotion behaviors, Gayes and Steele[25] found that MI had an effect size (Hedges' g) of 0.28 when compared to other active treatments and to no treatment. Their results also suggest that interventions focused on parent-child dyads are more effective at improving pediatric health outcomes and behaviors than those focused on either the child or parent alone. However, this conclusion is tentative, as it is based on three studies and because parent-directed or parent-child dyad-directed interventions were not part of the inclusion criteria for this meta-analysis.

Family focused interventions have been found to be an effective means for enacting pediatric health behavior change across a wide range of behaviors.[26] One advantage of involving the parent in the intervention is that the intervention has greater potential to impact all of the children in the family, not just the index child.[24]

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Therefore, the purpose of this study was to conduct a meta-analysis to specifically examine the effect of parent-directed or parent-child dyad-directed motivational interviewing to improve pediatric health behaviors relative to controls. We examined effect sizes by type of health behavior and investigated several important predictors of the effect, identified a priori (e.g., child race/ethnicity, intervention setting, delivery method, dose, provision of feedback, intensity of MI, and degree of parental involvement).

Methods

Sample of studies and selection criteria. Studies were retrieved from: (1) electronic reference databases (PubMED, PsycINFO, CINAHL, The Cochrane Library, ERIC, and Web of Science) using a Boolean search strategy with the following keywords: (motivational interviewing OR motivational enhancement therapy) AND (parent OR caregiver OR guardian OR mother OR father OR birth parent OR biological parent OR adoptive parent OR foster parent OR step parent) AND (intervention OR prevention OR education*); (2) reference sections of relevant review or published studies; and (3) sending manuscript requests to relevant authors. Two authors independently examined the full-text papers of relevant records obtained from the electronic database searches using our inclusion criteria.

To be included, studies had to: (1) sample parents of children and/or adolescents 18 years old or younger (participants); (2) implement an intervention that used MI or motivational enhancement that targeted either a parent or a parent-child dyad (interventions); (3) compare the intervention group to a control condition (e.g., assessment only, active comparison; comparisons); (4) examine modifiable health behaviors related to one of the leading health indicators specified in Healthy People 2020[27] (e.g., oral health, physical activity, diet and obesity, tobacco use, substance use, and responsible sexual behavior); (5) use a randomized controlled trial (RCT) design (study design); (6) be written in English; and (7) provide sufficient statistical information to calculate effect sizes.

Studies that fulfilled the selection criteria and were available by August 2014 were included. If an author reported insufficient statistical information, they were contacted for additional information. Two authors were contacted, but one was unable to provide the data by the date of data analysis (October 2014), resulting in the exclusion of a single study. (The number of studies is referred to as *k* throughout the manuscript).

Overview of the data collection process. Independent raters coded study information, participant characteristics, design and methodological features, treatment fidelity and methodological quality (**MQ**), and intervention content for the studies included in the meta-analysis. A coding protocol and form were developed to extract the aforementioned data from each individual study. Studies that reported intervention details or data from the same sample were linked together in the database and coded as a single study to avoid violating the assumption of independence. When a study used more than one comparison condition (e.g., usual care or usual care with reduced measurement[28]), the condition with the least intervention contact and the same assessment schedule was used as the comparison condition for ease of interpretation of treatment effects. (The magnitude of the effect sizes will be stronger when comparing an assessment only control versus an active comparison.[29])

Study features coded. Studies were coded for a number of characteristics, including sample characteristics, intervention setting, intervention dose, provider characteristics, target of intervention (parent only, parent-child dyad, child with ancillary parental involvement, group treatment), and MI components (see Table 2 for details).

Methodological quality and treatment fidelity. MQ was assessed using 14 items (e.g., random assignment, retention) adapted from validated measures[30-32]; and the total possible MQ score was 20 points. Treatment fidelity was assessed using a shortened, 15-item version of the validated treatment fidelity checklist developed by the National Institutes of Health (**NIH**) Treatment Fidelity Framework.[33,34] Items were scored as present (1) or absent (0). Studies that did not report the treatment fidelity item were also assigned a zero. Overall proportion of adherence to treatment fidelity was calculated by summing the total number of items coded as present by the total number of items considered applicable to the trial (Table 3).

Study outcomes coded. Estimates of effect sizes were calculated by one of this study's authors and verified by the first and/or second authors. Effect sizes were calculated from the information provided in the study or in a related study (i.e., when study outcomes were reported in multiple papers). Effect sizes were calculated for behavioral or biomedical health outcomes. Behavioral outcomes included: (1) oral health hygiene and maintenance behaviors (i.e., brushing, visiting the dentist, precavity checks, not sharing utensils); (2) overweight and obesity concerns (i.e., physical activity, healthy food servings, screen viewing access and time); (3) tobacco use (i.e., smoking cessation, environmental smoking restrictions); and (4) alcohol use. Biomedical outcomes included: (1) oral health (i.e., dental caries); (2) body composition (i.e., BMI, proportion of overweight or obese, waist circumference, proportion of body fat); and (3) tobacco exposure (i.e., secondhand smoking). Self-report and objective measures were used to evaluate the behavioral and biomedical outcomes.

Hypothesized predictors. Based on a priori hypotheses, several features of the studies were evaluated as potential predictors of the variation in the effect size distribution. Sample characteristics included parent and child race/ethnicity (Caucasian versus non-Caucasian). Intervention features included: (1) setting (clinical versus nonclinical); (2) delivery method (intervention delivered in person only versus any other method or combination of methods); (3) number of intervention sessions using MI; (4) treatment dose (total number of minutes of contact besides assessment) (5) the provision of personalized health-related feedback (versus no feedback); (6) number of MI components; (7) target of the intervention (e.g., whether studies with more parental involvement had better outcomes than those in which the parent had only ancillary involvement); and (8) provider type (whether interventions that were delivered by those with a professional terminal degree, with or without paraprofessional involvement, had better outcomes than those delivered by para-professionals alone, or lay providers alone).

Effect size derivation. Study effect sizes were calculated as the standardized mean difference between the treatment and comparison groups divided by the pooled standard deviation.[35] We used other statistical information, such as *t*- or *F*-values, when means and standard deviations were not available.[36] If a study reported dichotomous outcomes, we calculated an odds ratio and transformed it to *d* using the Cox transformation.[37] Effect sizes were adjusted for baseline differences when preintervention measures were available.[38] If no statistical

information was available (and could not be obtained from the authors) and the study reported no significant between-group differences, we estimated that effect size to be zero.[36,39] Multiple effect sizes were calculated from individual studies when they reported more than one outcome of interest or assessed outcomes across multiple follow-ups. If a study contained multiple measures of the same outcome (e.g., nutrition measured using two items for fruit and vegetable servings), the effect sizes were averaged. All effect sizes were corrected for sample size bias.[40]

The effect sizes from the last study assessment (50 percent of the studies reported more than one follow-up) were used in the analyses because initial intervention effects tend to decay over time.[41] Using the last assessment as the point of analysis provides a stronger test of the robustness of the interventions. Positive effect sizes indicate that participants receiving the MI-based intervention indicated a greater health benefit (e.g., lower tobacco use, fewer dental caries) relative to comparison groups.

Statistical analyses. Weighted mean effect sizes (d_+) were calculated using random-effects procedures, such that individual studies' effect sizes were weighted by the inverse of their random-effects variance.[36] The homogeneity statistic, Q, was calculated for each health behavior or biomedical outcome. A significant Q indicates a lack of homogeneity and an inference of heterogeneity. The I^2 index and the corresponding 95 percent confidence intervals (**CIs**) were also calculated to assess the extent to which outcomes were consistent across studies (homogeneous).[42,43] If the 95% CI around the I^2 index includes a zero, the hypothesis of homogeneity is confirmed.[42] To explain variability in effect sizes, meta-regression was conducted to determine the relationship between sample, methodological, or intervention characteristics and the magnitude of the effect sizes using a modified weighted regression analysis, with weights equivalent to the inverse of the variance for each effect size.[36,44] These analyses were conducted if the weighted mean effect size for a health behavior or biomedical outcome indicated significant heterogeneity and was reported in five or more studies. All analyses were conducted in Stata 13 (StataCorp LP, College Station, Texas, USA) using published macros.[36,45]

Publication bias. Publication bias (i.e., when studies with significant findings are published, whereas studies with non-significant findings remain unpublished; also known as the file-drawer effect)[46] was assessed by inspecting funnel plots[47] assessing the degree of funnel plot asymmetry using Begg's[48] and Egger's[49] methods and by determining the number of studies that could be missing using trim and fill procedures.[50]

Results

Study selection and reliability of coding. A total of 25 studies were included in the meta-analysis (Figure 1). For the categorical dimensions, raters agreed on 74 percent of the judgments (mean Cohen's κ=0.47, indicating moderate agreement[51]). Reliability for the continuous variables was calculated using the intraclass correlation coefficient (**ICC**); and the mean ICC equaled 0.78 across categories. Coding disagreements were resolved through discussion or by a third rater when consensus could not be achieved. Details for each study are provided in Table 1.

Study and sample characteristics. Table 2 provides aggregate information on the sample and intervention characteristics
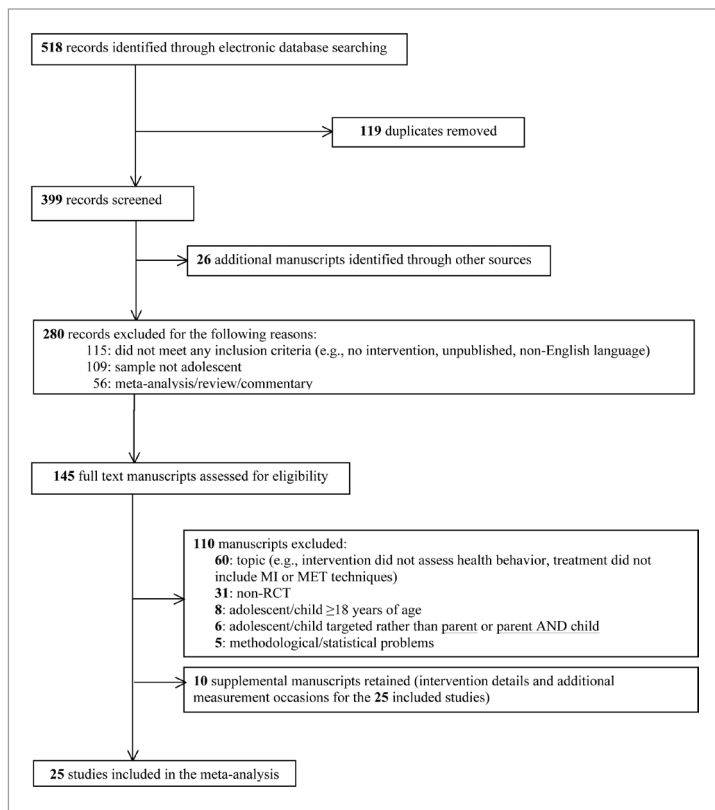

Figure 1. Selection process for study inclusion in the meta-analysis.

of the 25 studies included in the meta-analysis. Studies were published between 2001 and 2014, with a median publication date of 2011. Studies were typically conducted in the United States (72 percent) and in clinical settings (56 percent). Interventions focused on: (1) overweight and obesity (diet, weight, physical activity, and/or diabetes; 48 percent); (2) smoking and tobacco (cessation, secondhand smoke exposure; 32 percent); (3) oral health (e.g., dental caries, brushing; 16 percent); and (4) alcohol use (four percent). The median number of postinter-vention assessments was two (range = 1 to 3). The final postintervention assessment (used in the data analyses) occurred a median of 26 weeks (mean equals 38 weeks; ± standard deviation [**SD**] equals 35), but ranged from immediate post-intervention to 104 weeks. Our sample consisted of 5,130 parents (mean age=33 years, 93 percent female) or children (mean age=nine years, 56 percent female) with an average retention rate of 79 percent.

MI intervention characteristics. Interventions were typically delivered over multiple sessions, with a median of 26 minutes per session, by a single facilitator. MI was used in 74 percent (±0.36 SD) of the intervention sessions (median equals three sessions, range = 1 to 16), and 16 of the 25 studies used MI in 100 percent of their sessions. Interventions were typically delivered to a parent alone (52 percent), a child with ancillary parental involvement (12 percent), and parent-child dyads (eight percent); 28 percent of studies used a combination of these targets (e.g., parent-child dyads plus groups). All of the studies delivered MI in person for at least one session; approximately half were supplemented by telephone counseling and/or print. All 25 studies also stated that the intervention

Table 1. STUDY, SAMPLE, AND INTERVENTION DETAILS FOR THE 25 RANDOMIZED CONTROLLED TRIALS INCLUDED IN THE META-ANALYSIS*

Study	N	Intervention composition	Child's age (mean yrs)	Child's ethnicity	Target	Study outcomes	Sessions (no.)	MI sessions (no.)	Total dose[c]	MI components (no.)
Ball et al.[60]	31[a]	C/AP	15	90% CA	Overweight and obesity	Body mass index (+) Waist circumference (+)	16	16	840	2
Barkin et al.[61]	72	Dyad/GRP	9	100% L	Overweight and obesity	Body mass index (+)	6	6	345	0
Black et al.[62]	235	C/AP	13	100% AA	Overweight and obesity	Physical activity (-) Nutrition (+) Body mass index (+) % overweight/obese (+)	12	12	NR	2
Borrelli et al.[14]	133	P	7	100% L	Smoking and tobacco	Smoking cessation (+)	4	2	166	11
Brown et al.[63]	191	C/AP	15	95% CA	Smoking and tobacco	Smoking cessation (+)	5	2	150	3
Colby et al.[64]	162	P/C	16	72% CA	Smoking and tobacco	Smoking cessation (+)	3	3	80	5
Davoli et al.[65]	372	Dyad	4	NR	Overweight and obesity	Physical activity (+) Screen viewing time (+) Nutrition (+) Body mass index (+) % overweight/obese (+)	5	5	225	4
Eakin et al.[66]	350	P	4	92% AA	Smoking and tobacco	Smoking cessation (+) Smoking ban (+) Secondhand smoking (NR)	5	5	103	11
Emmons et al.[67] Linked studies[68]	323	P	NR	NR	Smoking and tobacco	Smoking cessation (NR) Secondhand smoking (+)	5	1	78	6
Freudenthal and Brown[58]	72	P	1	NR	Oral health	Oral health management (+)	3	1	55	8
Haines et al.[69]	121	P	4	51% L	Overweight and obesity	Screen viewing time (+) Screen access (+) Body mass index (+)	8	8	NR	1
Halterman et al.[70]	530	P	7	63% AA	Smoking and tobacco	Secondhand smoking (+)	3	3	50	11
Harrison et al.[57] Linked studies[71]	272	P	NR	100% Cree	Oral health	Dental caries (+)	7	7	158	2
Harutunyan et al.[54]	250	Dyad	4	100% Armenian	Smoking and tobacco	Smoking cessation (+) Smoking ban (+) Secondhand smoking (+)	3	3	60	1
Ismail et al.[53]	1021	P	5	100% AA	Oral health	Nutrition (+) Dental caries (NR) Oral health management (+)	1	1	55	7
Linakis et al.[52]	89	Dyad	13	71% CA	Alcohol	Alcohol use (-)	3	3	43	6
MacDonell et al.[72]	49	Dyad	15	100% AA	Overweight and obesity	Physical activity (-) Nutrition (+) Body mass index (+)	4	4	240	3
Neumark-Sztainer et al.[73] Linked studies[74-76]	433	C/AP/GRP	16	28% AA	Overweight and obesity	Physical activity (+) Screen viewing time (+) Nutrition (+) Body mass index (+)	103	6	NR	7
Resnicow et al.[77]	147	C/Dyad/GRP	14	100% AA	Overweight and obesity	Body mass index (-) Waist circumference (+)	29	5	NR	5

Table continues on next page

Table 1.   Continued

Study	N	Intervention composition	Child's age (mean yrs)	Child's ethnicity	Target	Study outcomes	Sessions (no.)	MI sessions (no.)	Total dose[c]	MI components (no.)
Small et al.[78]	67	P	6	NR	Overweight and obesity	Body mass index (+) Waist circumference (+)	8	4	240	3
Stotts et al.[28]	104[b]	P	NR	NR	Smoking and tobacco	Smoking ban (+)	2	2	75	5
Taveras et al.[79]	475	P	5	57% CA	Overweight and obesity	Screen viewing time (+) Screen access (+) Nutrition (+) Body mass index (+)	7	7	145	3
Van Grieken et al.[80] Linked studies[81,82]	637	P	6	78% Dutch	Overweight and obesity	Body mass index (-) % overweight/obese (-) Waist circumference (+) Physical activity (+) Nutrition (+) Screen viewing time (+)	3	3	180	0
Van Wely et al.[83] Linked studies[84]	50	C/Dyad/GRP	10	100% Dutch	Overweight and obesity	Physical activity (+)	5	2	NR	2
Weinstein et al.[10] Linked studies[9,85]	240	P	11	100% Punjabi	Oral health	Dental caries (+)	7	1	150	9

*N=number of consenting participants; C=child; P=parent; AP=ancillary parent; Dyad=parent-child dyad; GRP=group; CA=Caucasian; AA=African. American; L=Latino (a); MI=motivational interviewing; NR=not reported. A positive (+) or negative (-) sign after the study outcomes indicates the direction of the study-level effect size (i.e., treatment group improved or control group improved).

a The Youth Lifestyle Program (YLP) treatment condition is excluded because it did not use motivational interviewing techniques.

b The Usual Care—Reduced Measurement control condition is excluded because measures were unavailable for 1- and 3-month follow-up.

c Estimated number of minutes of intervention content excluding measurement.

content was tailored to the population, but only 64 percent (16/25) said they developed targeted intervention content from formative work.

Intervention content included: health-related education (100 percent); strategies to modify health behaviors (68 percent); and personalized risk assessments (44 percent). Most interventions provided general health-related materials (e.g., pamphlets; 76 percent) and/or boosters to enhance the intervention (88 percent). As shown in Table 2, the MI components used by more than half of the studies were collaboration (k=20), evocation (k=15), patient-centeredness (k=14), and autonomy (k=13). Studies, on average, described five MI components (±3.39 SD, range = zero to 11).

Description of the comparison conditions. Comparison conditions included assessment-only controls (28 percent) as well as active treatment comparisons (72 percent). The latter were typically delivered in a single session with a median of 13 minutes. Of the 18 studies with active controls, 13 provided content relevant to the target behavior (11 not time matched; two time-matched), two provided general health content (one not time matched; one time-matched), and three provided standard education only.

Methodological quality and treatment fidelity. Methodological quality of the studies ranged from nine to 17 (out of 20), with an average score of 14 (±1.96 SD). Overall, the studies satisfied an average of 70 percent (±0.10 SD) of the

MQ criteria, indicating moderate to strong MQ. The total MQ score was not significantly correlated with any behavioral or biological outcome (P>.16).

The mean proportion adherence to treatment fidelity strategies was 40 percent (±19 SD). Most studies reported using theoretical models or clinical guidelines to guide their intervention (76 percent), but only a minority of studies assessed whether the provider acquired the intervention skills after training (20 percent) or included an assessment to examine whether the provider adhered to the intervention during the delivery (40 percent). Full details of the treatment fidelity strategies assessed appear in Table 3.

Efficacy of the MI interventions compared with comparison groups by health outcome. Table 4 provides the weighted mean effect sizes and homogeneity statistics by health-related behavioral and biomedical outcomes. Compared to comparison groups, participants who received an MI intervention reported improvements in their health-related behaviors at the final postintervention assessment. Parents in the MI intervention condition were more likely than comparison groups to report: increasing the oral health hygiene and management of their children (d_+=0.38, 95% CI =0.08, 0.68); increases in children's level of physical activity (d_+=0.15, 95% CI=0.03, 0.28); reductions in children's screen viewing time (d_+=0.16, 95% CI= 0.03, 0.29); less screen access for their children (d_+=0.19, 95% CI=0.02, 0.36); improvement in their children's

Table 2.	DESCRIPTION OF STUDY, SAMPLE, AND INTERVENTION CHARACTERISTICS OF THE 25 INCLUDED STUDIES
Study characteristics	
Publication year, median (range)	2011 (2001-2014)
U.S. region: No. (%)	18 (72)
Research design and implementation	
Intervention setting: No. (%)	
Clinical	14 (56)
Nonclinical	11 (44)
Target outcome, no. (%)	
Alcohol	1 (4)
Oral health	4 (16)
Overweight and obesity	12 (48)
Smoking and tobacco	8 (32)
Postintervention assessments, median (range)	2 (1-3)
Methodological quality rating, median (range)	14 (9-17)
Sample characteristics	
Sample size, initial/final	6,513/5,130
Child	
Age, M±(SD)	9±(5)
Girls, M%±(SD)	56±(18)
Race/ethnic, M%±(SD)‡	
Caucasian	25±(36)
African American	36±(43)
Hispanic/Latino	20±(34)
Asian	2±(7)
Other	37±(48)
Parent	
Age, M±(SD)	33±(6)
Women, M%±(SD)	93±(7)
Race/ethnic, M%±(SD)‡	
Caucasian	13±(24)
African American	17±(33)
Hispanic/Latino	27±(40)
Asian	<1±(<1)
Other	54±(51)
Intervention characteristics	
Intervention dose, median (range)	
Sessions	5 (1-103)
MI sessions	3 (1-16)
Mins per session	26 (14-60)
Intervention session participant, no. studies†	
Parent only	15
Child only	3
Parent-child dyad	5
Child with ancillary parent	4
Group	3
Other	1
Facilitators, median (range)	1 (1-4)
Facilitators, no. studies†	
Peers	2
Paraprofessionals	11
Professional-in-training	2
Professionals	16
None/NR	2

Table 2.	Continued
Intervention characteristics (continued)	
Delivery, no. studies†	
In-person	25
Facilitated by computer/technology	4
Electronic/postal mail	6
Print materials	6
Phone and/or pager	14
Intervention content tailored, no. (%)	25 (100)
Intervention content targeted, no (%)	16 (64)
Intervention content, no. (%)†	
Health information/education	25 (100)
Personalized risk assessment	11 (44)
Oral feedback	4 (36)
Written feedback	2 (18)
Both	5 (45)
Moderation strategies provided	17 (68)
Provided general health-related materials	19 (76)
Boosters or other relevant materials	22 (88)
MI components, no. (%)†	
Patient-centered	14 (56)
Autonomy	13 (52)
Expresses empathy	9 (36)
Evocation	15 (60)
Collaboration	20 (80)
Open-ended questions	8 (32)
Reflections	9 (36)
Affirmation	8 (32)
Permission	8 (32)
Values clarification	6 (24)
Decisional balance exercise	7 (28)
Treatment fidelity, M%±(SD)	40±(19)
Control characteristics	
Active control, no. (%)	18 (72)
Control dose, median (range)	
Sessions	2 (1-64)
Minutes per session	13 (5-60)
Control session participant, no. studies†	
Parent only	11
Child only	4
Parent-child dyad	4
Group	2
Facilitators, median (range)	1 (0-4)
Facilitators, no. studies†	
Peers	1
Paraprofessionals	5
Professionals	7
None/NR	7
Delivery, no. studies†	
In-person	10
Facilitated by computer/technology	2
Electronic/postal mail	3
Print materials	7
Phone and/or pager	3

* M=mean; SD=standard deviation; NR=not reported.
† Multiple categories were possible.
‡ Complete or partial race/ethnic information was provided in a subset of studies for the child ($k \leq 18$) and/or the parent ($k \leq 10$).

diet (d_+=0.24, 95% CI=0.09, 0.39); quitting smoking (d_+=0.33, 95% CI=0.03, 0.68); and employing greater smoking restrictions (d_+=0.17, 95% CI=0.01, 0.34). Linakis et al.[52] met the inclusion criteria, but we could not calculate an overall weighted mean effect size, because it was the only study that measured alcohol use (d=0.91; 95% CI=0.45, 1.37).

In terms of biometric measures, children in the MI intervention conditions had a lower BMI at the final assessment (d_+=0.13, 95% CI=0.02, 0.25) versus children in the comparison groups. The weighted mean effect size for dental caries was not significant but included one study in which the effect size was estimated as zero.[53] Removing this study resulted in an overall weighted mean effect size for dental caries: d_+=0.36 (95% CI=0.18, 0.55); k=2, Q [1]=0.24; heterogeneity was not significant. There were no differences between the MI intervention and comparison parents on the other biometric measures assessed (i.e., proportion of overweight/obese, waist circumference, proportion of body fat, or objectively measured secondhand smoke exposure).

Homogeneity tests revealed significant heterogeneity for dental caries and the proportion of overweight/obese ($P \geq .001$). Sources of heterogeneity could not be explored for these outcomes due to the limited number of studies assessing dental caries (k=3) and the proportion of overweight/obese (k=3). The hypothesis of homogeneity was supported for BMI and all behavioral outcomes, except for diet (i.e., healthy food consumption) and smoking cessation; meta-regression analyses were conducted for these two variables.

Meta-regression analyses. Meta-regression analyses were used to examine whether sample or intervention characteristics (determined a priori) related to the variability in the effect size distribution associated with diet (i.e., consumption) and smoking cessation rates.

Diet. MI interventions were more successful at improving diet when the study sampled more Caucasians (β=0.80, P=.051, $Q_{Residual}$ [1]=3.81) and the intervention included more MI components (β=0.81, P=.047, $Q_{Residual}$ [1]=3.93). The interventions were less successful at improving diet when the intervention was delivered in person (β = -0.80, P=.051, $Q_{Residual}$ [1] = 3.81); however, this finding may be spurious, as only a single study used delivery methods other than in person alone. No other intervention feature moderated the intervention impact on diet (i.e., food consumption).

Smoking cessation. Participants in the MI intervention were more successful at quitting smoking when the intervention with the total dose delivered (number of sessions times number of minutes) was less (β equals -0.38, P=.035, $Q_{Residual}$ [1]=4.43), used fewer MI components (β=-0.59, P<.001, $Q_{Residual}$ [1]=11.00), and had less parental involvement (β=-0.67, P<.001, $Q_{Residual}$ [1]=13.95). No other sample or intervention features moderated the intervention impact on smoking cessation. Supplemental analyses indicated that the meta-regression analyses were substantially influenced by a single study.[54] No significant predictors of smoking cessation were detected when the outlier was excluded.

Publication bias. We intended to assess funnel plot asymmetry and perform formal statistical tests for publication bias (i.e., Egger,[49] Begg[48]) but were unable to do so given the small number of studies available for each outcome (i.e., less than 10 studies).[55] Assessment of the funnel plot for BMI revealed no asymmetries that might be interpreted as publication bias. Results from Egger's[49] (P=.952) and Begg's[48] (P=.472) tests were non-significant. The funnel plot for BMI is presented in the supplemental digital content.

Discussion

The aim of our meta-analysis was to evaluate the effect of parent-involved MI on modifiable pediatric health behaviors and biomedical outcomes. Our results showed that, relative to comparison groups, parent-involved MI was associated with significant improvements in health behaviors (oral health management, diet, physical activity, reduced screen time and access, smoking cessation, and household smoking restrictions) and biomedical outcomes (reduced BMI and dental caries). Because there were only two studies on dental caries with usable data, these results, while promising, should be interpreted with caution. We did not find an effect of parent-involved MI on other biomedical outcomes (proportion of overweight/obese, waist circumference, proportion of body fat, or objectively measured second hand smoke exposure). Our meta-analysis contributes to extant literature because of its evaluation of the:

Table 3. TREATMENT FIDELITY CHECKLIST		
Treatment fidelity categories	Treatment fidelity strategies	Proportion (%)
Treatment design	Mention of provider credentials	72
	Mention of a theoretical model or clinical guidelines on which the intervention is based	76
Training providers	Description of how providers were trained	44
	Standardized provider training	60
	Measured provider skill acquisition post-training	20
	Described how provider skills maintained over time	56
Delivery of treatment	Method used to ensure that the content of the intervention was being delivered as specified	36
	Method used to ensure that the dose of the intervention was being delivered as specified	20
	Included mechanisms to assess if the provider actually adhered to the intervention	40
	Assessment of nonspecific treatment effects	12
	Use of treatment manual	56
Receipt of treatment	Assessment of the degree to which the participants understood the intervention	4
	Specified strategies used to improve the participant comprehension of the intervention	64
Enactment of treatment skills	Assessed participant performance of the intervention skills in settings in which the skills might be applied	20
	Assessed strategy to improve participant performance of the intervention skills in settings in which the skills might be applied	24

(1) effect of parental involvement in pediatric health behavior change; (2) number and type of MI components included in the intervention; and (3) treatment fidelity in general and in relation to specific features important for the delivery of MI (e.g., type of training, acquisition of MI skills, maintenance of MI skills over time). We also used rigorous criteria to evaluate outcomes, such that only the final evaluation point was used to assess the effect of MI on outcomes.

We found a significant effect of MI on oral health behaviors and management (e.g., toothbrushing, visiting the dentist) versus comparison groups across the four studies that met inclusion criteria. While three of these studies also included dental caries as an outcome, only two had sufficient data to be included in the analyses. Consistent with meta-analytic methodology,[36] we conservatively estimated the effect of the study to be zero. When all three studies were included in analyses, there was no MI effect on reducing pediatric dental caries; however, when only the studies with data were included, there was a significant MI effect. Although this estimate is based on a moderate

sample size (N equals 443), additional studies are needed to confirm this effect. Gao et al.[56] performed a systematic review of 16 randomized controlled trials that evaluated the effectiveness of MI compared with health education on oral health behaviors among adults and children. Among adults, they found that MI was associated with improved periodontic health in five of seven trials, but the five trials with positive effects had short-term outcomes (less than eight weeks), whereas the two trials with negative effects had longer-term outcomes.

In terms of preventing early childhood caries, Gao et al.'s review included four studies that targeted oral health in children; all were included in our meta-analysis.[10,53,57,58] Our meta-analyses supports their finding that MI is associated with improvements in pediatric oral health behavior; however, our finding should be interpreted with caution, as it is based on a small number of studies evaluating parent-based MI interventions. Additional studies of the effect of parent-based MI on oral health behaviors and outcomes are needed, particularly those that involve objective measures of caries. One such trial is underway (NIDCR U54 DEO192745), involving training of lay providers to deliver MI to low-income and ethnically diverse caregivers of zero- to five-year-olds to improve pediatric oral health. In this trial, both oral health behaviors and objectively measured caries are assessed longitudinally.

MI outperformed comparison treatments across all other health behaviors that were included in the articles in our meta-analysis, such as employing greater household smoking restrictions, quitting smoking, physical activity, screen viewing time and access, and diet. Effects ranged from small (d_+=0.17 for household smoking restrictions) to medium (d_+=0.38 for oral health behaviors). These results are conservative, as we used the final assessment point to estimate the effect of MI. Use of more proximal assessment points may have resulted in stronger effects. It was surprising that MI had a clearly significant effect on only one biomedical outcome (BMI) and a promising effect for another (dental caries). Meta-analyses of the effect of MI on physical health outcomes in adults have shown significant effects for BMI, HbA1c, blood cholesterol, and systolic blood pressure.[22]

Meta-regression analyses assessed whether sample or intervention characteristics were related to the variability of the effect size distribution for two outcomes that met the criteria for heterogeneity: diet and smoking cessation. MI interventions were more successful at improving diet when the study had a greater number of Caucasians in the sample. Our findings are in contrast to prior meta-analyses that found significantly larger effects of MI for minority versus nonminority populations.[20] Differences may be due to the isolation of specific health behaviors (i.e., diet) rather than combining all behavioral outcomes. Future research should evaluate whether parent-based MI interventions are more effective for minority versus nonminority populations. We also found that MI interventions were more successful at improving diet when the intervention included more MI components. Previous meta-analyses have not found a relationship between the intensity of MI and outcome; this may be due to the fact that effect sizes were computed across behaviors.[25] (Contemporary

Table 4.   EFFICACY OF MOTIVATIONAL INTERVIEWING (MI) INTERVENTIONS RELATIVE TO CONTROL CONDITIONS*

Outcome	N	k	d+ (95% CI)	Q	I² (95% CI)
Behaviors					
Oral health					
Hygiene/management	667	2	0.38 (0.08, 0.68)	1.75	43 (0, 84)
Overweight/obesity					
Physical activity	1,223	6	0.15 (0.03, 0.28)	5.97	16 (0, 61)
Screen viewing time	1,554	5	0.16 (0.03, 0.29)	6.52	39 (0, 77)
Screen viewing access	549	2	0.19 (0.02, 0.36)	0.78	0
Diet	2,231	7	0.24 (0.09, 0.39)	17.88**	66 (25, 85)
Smoking/tobacco					
Smoking cessation†	1,153	6	0.33 (0.03, 0.63)	31.17**	84 (67, 92)
Smoking restrictions	574	3	0.17 (0.01, 0.34)	0.27	0
Biometric screening					
Oral health					
Dental caries†	1,045	3	0.23 (-0.05, 0.50)	8.64**	77 (25, 93)
Overweight/obesity					
Body mass index	2,259	11	0.13 (0.01, 0.25)	16.98	41 (0, 71)
Proportion of overweight/obese	1,188	3	0.17 (-0.10, 0.44)	9.80**	80 (35, 94)
Waist circumference	670	4	0.08 (-0.07, 0.23)	0.39	0
Proportion body fat	642	3	0.10 (-0.12, 0.32)	3.45	42 (0, 82)
Smoking/tobacco					
Secondhand smoking†	1,226	4	0.05 (-0.06, 0.16)	0.21	0

* CI=confidence interval. Weighted mean effect sizes ($d+$) are positive for differences that favor the treatment group relative to the control group. N=number of participants; k=number of studies; CI=confidence interval; Q=homogeneity statistic; I2=consistency of effect sizes.

** Heterogeneity is significant at $P<.05$.

† The weighted mean effect sizes for smoking cessation,[67] dental caries,[53] and secondhand smoking[66] was estimated as 0 for a single study. The overall weighted mean effect size for smoking cessation, dental caries, and secondhand smoking, after eliminating the estimated effect size, is $d+$=0.40 (95% CI=0.08, 0.73), k=5, Q (4)=22.11, $P<.001$, $d+$=0.36 (95% CI=0.18, 0.55), k=2, Q (1)=0.24, $d+$=0.06 (95% CI=-0.06, 0.19), k=2, Q (2)=0.01.

meta-analytic methods compare subcategories of mean effect sizes rather than averaging the effect sizes from distinctly different outcomes.[36]) Several predictors of smoking cessation (e.g., intervention dose, level of parental involvement, and use of MI components) were found, but these results must be interpreted with caution as subsequent analyses indicated that the results were largely influenced by a single study. Therefore, more studies should be conducted to add to these data.

Treatment fidelity was low across the studies in our sample. The proportion of adherence to treatment fidelity strategies was 0.40 (±0.19 SD). Borrelli et al.[34] evaluated treatment fidelity in papers published in five peer-reviewed health behavior journals over 10 years and found a 55 percent adherence rate to treatment fidelity strategies, with only 16 percent of articles achieving more than 0.80 proportion adherence to the checklist. In the current study, none of the studies achieved greater than 0.80 proportion adherence, and only nine studies achieved more than 50 percent adherence to strategies. Only four of the studies in our sample used the Motivational Interviewing Treatment Integrity Coding[59] to objectively rate whether or not MI was delivered. Therefore, we cannot conclude with certainty that MI was actually implemented in the majority of the studies included in the meta-analysis. Future studies of the effect of MI on pediatric health can benefit from greater attention to treatment fidelity, especially in the areas of assessment of initial acquisition of MI skills, monitoring skills over time, and assessment of whether or not the intervention was delivered as specified.

Our meta-analysis is the only one that assessed whether or not the articles mentioned delivering specific MI components. The vast majority of trials included in our meta-analysis indicated that their MI intervention involved collaboration (k=20 out of 25), and most of the trials indicated that their MI intervention involved evocation (k=15), patient-centeredness (k=14), and autonomy (k=13). Less than half of the trials indicated that they delivered other components that are central to the spirit of MI (e.g., empathy, reflections, open-ended questions, affirmations, asking permission, decisional balance, and values clarification). It is unknown whether these components were delivered and not mentioned in the papers or whether these components were not delivered at all. Either way, lack of reporting or lack of implementation makes it difficult for readers to make strong conclusions about the effect of MI or to replicate findings and test mechanisms of the effects.

Our meta-analysis shows that parent-involved MI is effective in changing pediatric health behaviors, reducing BMI, and having a promising effect on dental caries. As of October 2014, 192 trials are currently funded by the NIH using MI. Many more trials have been conducted and concluded since the inception of MI. MI is increasingly being incorporated into medical education as a patient-centered method of assessment and intervention. The majority of the studies included in our meta-analyses were implemented in clinical settings or by phone supporting the feasibility of implementation by providers. Future research should focus on examining the effects of parent-involved MI on both behavior and health outcomes in longitudinal designs. Furthermore, greater attention needs to be paid to treatment fidelity in order to improve both internal and external validity. Additionally, MI training and intervention features should be described in greater detail in published articles or online supplements for the purpose of aiding in interpretability and replicability.

Conclusions

Based on this study's results, the following conclusions can be made:

1. There is evidence to support the use of parent-involved motivational interviewing in improving a variety of pediatric health behaviors and outcomes (e.g., oral health, diet, physical activity, reduced screen time, smoking cessation, reduced secondhand smoke, body mass index).
2. Parent-involved MI improves pediatric oral health behaviors. MI may be useful for reducing dental caries, but more studies are needed.
3. Parent-involved MI interventions were more successful at improving diet when the intervention included a greater number of MI components.
4. There is insufficient evidence to support the use of MI interventions for other weight-related outcomes (i.e., proportion of overweight/obese, waist circumference, proportion of body fat) or objectively measured secondhand smoke exposure.

References

1. Miller WR, Rollnick S. Motivational Interviewing: Preparing People for Change. 2nd ed. New York, N.Y., USA: Guilford Press; 2002.
2. Boardman T, Catley D, Grobe JE, Little TD, Ahluwalia JS. Using motivational interviewing with smokers: do therapist behaviors relate to engagement and therapeutic alliance? J Subst Abuse Treat 2006;31:329-39.
3. Miller WR, Benefield RG, Tonigan JS. Enhancing motivation for change in problem drinking: a controlled comparison of two therapist styles. J Consult Clin Psychol 1993;61:455-61.
4. Moyers TB, Martin T. Therapist influence on client language during motivational interviewing sessions. J Subst Abuse Treat 2006;30:245-51.
5. Miller WR. Motivational interviewing in service to health promotion. Am J Health Promot 2004;18:a1-a10.
6. Rollnick S, Miller WR, Butler C. Motivational Interviewing in Health Care: Helping Patients Change Behavior. New York, N.Y., USA: Guilford Press; 2008.
7. Hardcastle S, Taylor A, Bailey M, Castle R. A randomised controlled trial on the effectiveness of a primary health care based counselling intervention on physical activity, diet and CHD risk factors. Patient Educ Couns 2008; 70:31-9.
8. Channon SJ, Huws-Thomas MV, Rollnick S, et al. A multicenter randomized controlled trial of motivational interviewing in teenagers with diabetes. Diabetes Care 2007;30:1390-5.
9. Weinstein P, Harrison R, Benton T. Motivating mothers to prevent caries: confirming the beneficial effect of counseling. J Am Dent Assoc 2006;137:789-93.
10. Weinstein P, Harrison R, Benton T. Motivating parents to prevent caries in their young children: one-year findings. J Am Dent Assoc 2004;135:731-8.
11. Kemp R, Kirov G, Everitt B, Hayward P, David A. Randomised controlled trial of compliance therapy: 18-month follow-up. Br J Psychiatry 1998;172:413-9.
12. Drymalski WM, Campbell TC. A review of motivational interviewing to enhance adherence to antipsychotic medication in patients with schizophrenia: evidence and recommendations. J Ment Health 2009;18:6-15.

13. Greaves CJ, Middlebrooke A, O'Loughlin L, et al. Motivational interviewing for modifying diabetes risk: a randomised controlled trial. Br J Gen Pract 2008;58:535-40.

14. Borrelli B, McQuaid EL, Novak SP, Hammond SK, Becker B. Motivating Latino caregivers of children with asthma to quit smoking: a randomized trial. J Consult Clin Psych 2010;78:34-43.

15. Lundahl B, Moleni T, Burke BL, et al. Motivational interviewing in medical care settings: a systematic review and meta-analysis of randomized controlled trials. Patient Educ Couns 2013;93:157-68.

16. Rongkavilit C, Naar-King S, Wang B, et al. Motivational interviewing targeting risk behaviors for youth living with HIV in Thailand. AIDS Behav 2013;17:2063-74.

17. Hodgins DC, Currie SR, el-Guebaly N. Motivational enhancement and self-help treatments for problem gambling. J Consult Clin Psychol 2001;69:50-7.

18. Armstrong MJ, Mottershead TA, Ronksley PE, Sigal RJ, Campbell TS, Hemmelgarn BR. Motivational interviewing to improve weight loss in overweight and/or obese patients: a systematic review and meta-analysis of randomized controlled trials. Obes Rev 2011;12:709-23.

19. Burke BL, Arkowitz H, Menchola M. The efficacy of motivational interviewing: a meta-analysis of controlled clinical trials. J Consult Clin Psychol 2003;71:843-61.

20. Hettema J, Steele J, Miller WR. Motivational interviewing. Annu Rev Clin Psychol 2005;1:91-111.

21. Vasilaki EI, Hosier SG, Cox WM. The efficacy of motivational interviewing as a brief intervention for excessive drinking: a meta-analytic review. Alcohol Alcohol 2006;41:328-335.

22. Rubak S, Sandbaek A, Lauritzen T, Christensen B. Motivational interviewing: a systematic review and meta-analysis. Br J Gen Pract 2005;55:305-12.

23. Foxcroft DR, Coombes L, Wood S, Allen D, Almeida Santimano NM. Motivational interviewing for alcohol misuse in young adults. Cochrane Database Syst Rev 2014;8:CD007025.

24. Seitz V, Apfel NH. Parent-focused intervention: diffusion effects on siblings. Child Dev 1994;65:677-83.

25. Gayes LA, Steele RG. A meta-analysis of motivational interviewing interventions for pediatric health behavior change. J Consult Clin Psychol 2014;82:521-35.

26. Carr A. The effectiveness of family therapy and systemic interventions for child-focused problems. J Fam Ther 2009;31:3-45.

27. U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion. Healthy People 2020. Available at: "http://www.healthypeople.gov/". Accessed October 8, 2014. Archived by WebCite® at: "http://www.webcitation.org/6XoPQvAP0". Accessed April 15, 2015.

28. Stotts AL, Green C, Northrup TF, et al. Feasibility and efficacy of an intervention to reduce secondhand smoke exposure among infants discharged from a neonatal intensive care unit. J Perinatol 2013;33:811-6.

29. Grissom RJ. The magical number .7 +/- .2: meta-meta-analysis of the probability of superior outcome in comparisons involving therapy, placebo, and control. J Consult Clin Psychol 1996;64(2):973-82.

30. Jadad AR, Moore RA, Carroll D, et al. Assessing the quality of reports of randomized clinical trials: is blinding necessary? Controlled Clin Trials 1996;17:1-12.

31. Miller WR, Brown JM, Simpson TL, Handmaker NS, Bien TH, Luckie LF. What works? A methodological analysis of the alcohol treatment outcome literature. In: Hester RK, Miller WR, eds. Handbook of Alcoholism Treatment Approaches: Effective Alternatives. 2nd ed. Needham Heights, Mass., USA: Allyn and Bacon; 1995:12-44.

32. Miller WR, Wilbourne PL. Mesa Grande: A methodological analysis of clinical trials of treatments for alcohol use disorders. Addiction 2002;97:265-77.

33. Borrelli B. The assessment, monitoring, and enhancement of treatment fidelity in public health clinical trials. J Public Health Dent 2011;71:s52-s63.

34. Borrelli B, Sepinwall D, Ernst D, et al. A new tool to assess treatment fidelity and evaluation of treatment fidelity across 10 years of health behavior research. J Consult Clin Psychol 2005;73:852-60.

35. Cohen J. Statistical Power Analysis for the Behavioral Sciences. 2nd ed. New York, N.Y., USA: Erlbaum; 1988.

36. Lipsey MW, Wilson DB. Practical Meta-Analysis. Thousand Oaks, Calif., USA: Sage; 2001.

37. Sanchez-Meca J, Marin-Martinez F, Chacon-Moscoso S. Effect-size indices for dichotomized outcomes in meta-analysis. Psychol Methods 2003;8:448-67.

38. Morris SB, DeShon RP. Combining effect size estimates in meta-analysis with repeated measures and independent-groups designs. Psychol Methods 2002;7:105-25.

39. Pigott TD. Handling missing data. In: Cooper H, Hedges LV, Valentine JC, eds. The Handbook of Research Synthesis. 2nd ed. New York, N.Y., USA: Sage; 1994:399-416.

40. Hedges LV. Distribution theory for Glass's estimator of effect size and related estimators. J Educ Stat 1981;6:107-28.

41. Johnson BT, Scott-Sheldon LA, Carey MP. Meta-synthesis of health behavior change meta-analyses. Am J Public Health 2010;100:2193-8.

42. Huedo-Medina TB, Sanchez-Meca J, Marin-Martinez F, Botella J. Assessing heterogeneity in meta-analysis: Q statistic or I2 index? Psychol Methods 2006;11:193-206.

43. Higgins JP, Thompson SG. Quantifying heterogeneity in a meta-analysis. Stat Med 2002;21:1539-58.

44. Hedges LV. Fixed effects models. In: Cooper H, Hedges LV, eds. The Handbook of Research Synthesis. New York, N.Y., USA: Russell Sage Foundation; 1994:285-99.

45. StataCorp LP. Stata Statistical Software, 13.0. College Station, Texas, USA: StataCorp, LP; 2013.

46. Rosenthal R. The file drawer problem and tolerance for null results. Psychol Bull 1979;86:638-41.

47. Sterne JA, Egger M. Funnel plots for detecting bias in meta-analysis: guidelines on choice of axis. J Clin Epidemiol 2001;54:1046-55.

48. Begg CB, Mazumdar M. Operating characteristics of a rank correlation test for publication bias. Biometrics 1994;50:1088-101.

49. Egger M, Smith GD, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. BMJ 1997;315:629-34.

50. Duval S, Tweedie R. Trim and fill: a simple funnel-plot–based method of testing and adjusting for publication bias in meta-analysis. Biometrics 2000;56:455-63.

51. Landis JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics 1977;33:159-74.

52. Linakis JG, Bromberg J, Baird J, et al. Feasibility and acceptability of a pediatric emergency department alcohol prevention intervention for young adolescents. Pediatr Emerg Care 2013;29:1180-8.

53. Ismail AI, Ondersma S, Jedele JMW, Little RJ, Lepkowski JM. Evaluation of a brief tailored motivational intervention to prevent early childhood caries. Community Dent Oral 2011;39:433-48.

54. Harutyunyan A, Movsisyan N, Petrosyan V, Petrosyan D, Stillman F. Reducing children's exposure to secondhand smoke at home: a randomized trial. Pediatrics 2013;132: 1071-80.

55. Lau J, Ioannidis JPA, Terrin N, Schmid C, Olkin I. The case of the misleading funnel plot. Br Med J 2006;333: 597-600.

56. Gao X, Lo EC, Kot SC, Chan KC. Motivational interviewing in improving oral health: a systematic review of randomized controlled trials. J Periodontol 2014;85: 426-37.

57. Harrison RL, Veronneau J, Leroux B. Effectiveness of maternal counseling in reducing caries in Cree children. J Dent Res 2012;91:1032-7.

58. Freudenthal JJ, Bowen DM. Motivational interviewing to decrease parental risk-related behaviors for early childhood caries. J Dent Hyg 2010;84:29-34.

59. Moyers TB, Martin T, Manuel JK, Hendrickson SM, Miller WR. Assessing competence in the use of motivational interviewing. J Subst Abuse Treat 2005;28:19-26.

60. Ball GD, Mackenzie-Rife KA, Newton MS, et al. One-on-one lifestyle coaching for managing adolescent obesity: findings from a pilot, randomized controlled trial in a real-world, clinical setting. Pediatr Child Health 2011; 16:345-50.

61. Barkin SL, Gesell SB, Poe EK, Ip EH. Changing overweight Latino preadolescent body mass index: the effect of the parent-child dyad. Clin Pediatr (Phila) 2011;50: 29-36.

62. Black MM, Hager ER, Le K, et al. Challenge! Health promotion/obesity prevention mentorship model among urban, black adolescents. Pediatrics 2010;126:280-8.

63. Brown RA, Ramsey SE, Strong DR, et al. Effects of motivational interviewing on smoking cessation in adolescents with psychiatric disorders. Tob Control 2003;12(Suppl 4): IV3-10.

64. Colby SM, Nargiso J, Tevyaw TOL, et al. Enhanced motivational interviewing versus brief advice for adolescent smoking cessation: Results from a randomized clinical trial. Addict Behav 2012;37:817-23.

65. Davoli AM, Broccoli S, Bonvicini L, et al. Pediatrician-led motivational interviewing to treat overweight children: an RCT. Pediatrics 2013;132:e1236-e1246.

66. Eakin MN, Rand CS, Borrelli B, Bilderback A, Hovell M, Riekert KA. Effectiveness of motivational interviewing to reduce Head Start children's secondhand smoke exposure: a randomized clinical trial. Am J Resp Crit Care 2014;189:1530-1537.

67. Emmons KM, Hammond SK, Fava JL, Velicer WF, Evans JL, Monroe AD. A randomized trial to reduce passive smoke exposure in low-income households with young children. Pediatrics 2001;108:18-24.

68. Emmons KM, Wong M, Hammond SK, et al. Intervention and policy issues related to children's exposure

69. Haines J, McDonald J, O'Brien A, et al. Healthy Habits, Happy Homes: randomized trial to improve household routines for obesity prevention among preschool-aged children. JAMA Pediatr 2013;167:1072-9.

70. Halterman JS, Szilagyi PG, Fisher SG, et al. Randomized controlled trial to improve care for urban children with asthma: results of the School-Based Asthma Therapy trial. Arch Pediatr Adolesc Med 2011;165:262-8.

71. Harrison R, Veronneau J, Leroux B. Design and implementation of a dental caries prevention trial in remote Canadian Aboriginal communities. Trials 2010;11:54.

72. Macdonell K, Brogan K, Naar-King S, Ellis D, Marshall S. A pilot study of motivational interviewing targeting weight-related behaviors in overweight or obese African American adolescents. J Adolesc Health 2012;50:201-3.

73. Neumark-Sztainer DR, Friend SE, Flattum CF, et al. New moves-preventing weight-related problems in adolescent girls a group-randomized study. Am J Prev Med 2010; 39:421-32.

74. Neumark-Sztainer D, Flattum CF, Story M, Feldman S, Petrich CA. Dietary approaches to healthy weight management for adolescents: the New Moves model. Adolesc Med State Art Rev 2008;19(3):421-30, viii.

75. Neumark-Sztainer D, Story M, Hannan PJ, Rex J. New Moves: a school-based obesity prevention program for adolescent girls. Prev Med 2003;37:41-51.

76. Flattum C, Friend S, Story M, Neumark-Sztainer D. Evaluation of an individualized counseling approach as part of a multicomponent school-based program to prevent weight-related problems among adolescent girls. J Am Diet Assoc 2011;111:1218-23.

77. Resnicow K, Taylor R, Baskin M, McCarty F. Results of go girls: a weight control program for overweight African-American adolescent females. Obes Res 2005;13: 1739-48.

78. Small L, Bonds-McClain D, Melnyk B, Vaughan L, Gannon AM. The preliminary effects of a primary care-based randomized treatment trial with overweight and obese young children and their parents. J Pediatr Health Care 2014;28:198-207.

79. Taveras EM, Gortmaker SL, Hohman KH, et al. Randomized controlled trial to improve primary care to prevent and manage childhood obesity: the High Five for Kids study. Arch Pediatr Adolesc Med 2011;165:714-22.

80. van Grieken A, Veldhuis L, Renders CM, et al. Population-based childhood overweight prevention: outcomes of the 'Be active, eat right' study. PloSOne 2013;8(5):1-9.

81. van Grieken A, Renders CM, Veldhuis L, Looman CW, Hirasing RA, Raat H. Promotion of a healthy lifestyle among 5-year-old overweight children: health behavior outcomes of the Be Ative, Eat Right study. BMC Public Health 2014;14:59.

82. Veldhuis L, Struijk MK, Kroeze W, et al. Be Active, Eat Right: evaluation of an overweight prevention protocol among 5-year-old children: design of a cluster randomised controlled trial. BMC Public Health 2009;9:177.

83. Van Wely L, Balemans AC, Becher JG, Dallmeijer AJ. Physical activity stimulation program for children with cerebral palsy did not improve physical activity: a randomised trial. J Physiother 2014;60:40-9.

to environmental tobacco smoke. Prev Med 2001;32: 321-31.

84. Van Wely L, Balemans AC, Becher JG, Dallmeijer AJ. The effectiveness of a physical activity stimulation programme for children with cerebral palsy on social participation, self-perception and quality of life: a randomized controlled trial. Clin Rehabil 2014;28(10):972-82. doi: 10.11 77/0269215513500971. Epub 2013 Sep 18.

85. Harrison R, Benton T, Everson-Stewart S, Weinstein P. Effect of motivational interviewing on rates of early childhood caries: a randomized trial. Pediatr Dent 2007; 29(1):16-22.