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Systematic Review

Primary Health Education and Social Cognitive Theory in School Settings: A Systematic Review

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Abstract

Introduction: Schools offer sustained access to children during critical developmental periods, making them ideal settings for primary health education. Social Cognitive Theory (SCT) is frequently applied in school-based health interventions, yet no existing review has synthesized evidence across the full range of health domains, developmental stages, and intervention modalities. This systematic review synthesizes evidence on SCT-based primary health education interventions in school settings, examining effectiveness, theoretical fidelity, and methodological quality.

Methods: A systematic search of nine databases (2000–2025) identified 14 eligible studies employing SCT-based interventions with student-level outcomes and comparison groups. Study selection, data extraction, and quality assessment followed PRISMA 2020 guidelines.

Results: Interventions spanned nutrition, physical activity, obesity prevention, hygiene, and mental health. SCT-based interventions consistently improved knowledge and key constructs—particularly self-efficacy, behavioral capability, and social support. However, sustained behavioral and anthropometric changes were more variable. Longer, multicomponent interventions (>12 months) with environmental modifications and parental engagement demonstrated more consistent effects. Peer-led delivery showed superior knowledge gains (adjusted Odd Ratio = 6.04, $P<0.001$). Handwashing interventions were notably successful, with significant improvements in practices (Average Treatment Effect: 0.22, $P<0.001$). Self-efficacy was the most frequently targeted and improved construct, while outcome expectations showed mixed findings. Study quality varied; common limitations included lack of long-term follow-up, reliance on self-report, and absence of mediation analyses.

Conclusions: SCT provides a strong theoretical foundation for school health education, effectively enhancing knowledge and psychosocial determinants of behavior. However, translating knowledge gains into sustained behavior change remains challenging. Effective interventions require addressing multiple SCT constructs, interactive learning, parental engagement, adequate duration (≥12 months), and fidelity monitoring. Future research should prioritize mediation analyses, extended follow-up, objective measures, and cost-effectiveness evaluations.

Introduction

Few settings rival the school for delivering primary health education, since schools offer sustained and near-universal contact with children and adolescents during the formative years in which physical, cognitive, and social capacities are being shaped. Because this developmental period is so malleable, it offers a valuable window for interventions intended to establish durable health behaviors spanning diet, physical activity, substance-use avoidance, and mental-health literacy.[1] Within the World Health Organization's Health-Promoting Schools framework, schools are understood not merely as sites for individual

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behavior change but as integrated health-promoting ecosystems, where meaningful impact depends on coordinated curricular reform, organizational adaptation, environmental change, and the fostering of social climates that make healthier choices easier and more expected.[2] This premise finds empirical support in a Cochrane systematic review and meta-analysis of the Health-Promoting Schools framework, which reported modest but population-level meaningful effects on body mass index, physical activity, fruit and vegetable intake, and tobacco use—evidence that reinforces the public-health value of theory-driven, multi-level school approaches.[1] Later process evaluations of Health-Promoting Schools initiatives have pointed to several conditions for success, among them tailoring programmes to a given school's needs, aligning them with the school's own priorities, co-developing content with teachers, sustaining training and support over time, and adopting participatory strategies that involve school staff directly in delivery.[3] Such implementation lessons carry particular weight for theory-based interventions, which typically depend on the continued engagement of multiple stakeholders across the school system.

This whole-system, socioecological orientation raises the question of how any single theory of individual behavior fits within it. Social Cognitive Theory (SCT) offers one answer, because Bandura conceived it from the outset as a theory of the person acting within, and shaped by, an environment—not merely a theory of internal cognition—making it naturally compatible with a systems-level framework such as Health-Promoting Schools. Convergent evidence from domain-specific reviews supports SCT's prominence within school health promotion: an integrative review of school-based interventions targeting childhood overweight found that SCT served as the stated or implicit theoretical basis in eight of the ten studies examined,[4] and a broader systematic review of the behavioral models underlying preschool- and school-based obesity-prevention programs likewise identified SCT as the most commonly adopted model, with SCT-based studies tending to show significant, favorable changes in outcomes.[5] At the core of SCT lies the principle of reciprocal determinism, whereby behavior is understood to arise from an ongoing, two-way interaction among personal cognitive and emotional factors, behavioral patterns, and features of the environment.[6] Bandura himself later elaborated how SCT's component constructs—self-efficacy (confidence in one's capacity to perform a given behavior), outcome expectations (anticipated consequences of acting), observational learning through modelling, behavioral capability (the knowledge and skills required to act), and goal-setting together with self-regulation—translate into concrete health-promotion practice.[7] In school settings, these constructs are put into action through strategies such as structuring mastery experiences to build self-efficacy, using peer or teacher models to support observational learning, delivering health knowledge and practical skills, adjusting physical and policy environments to make healthy choices easier, and scaffolding students toward incremental goals.[6, 7]

A growing body of empirical work supports the effectiveness of SCT-based interventions across a range of school health domains. A recent systematic review of theory-based nutrition education interventions among school-aged adolescents confirmed SCT as the most commonly used framework, with eleven of the twelve included studies achieving favourable change in at least two food groups.[8] School-based physical activity programmes built on SCT constructs have shown comparable gains in activity levels, knowledge, and self-efficacy.[9] The Nutrition Education and Garden programme offers a concrete example: by combining hands-on gardening activities with classroom instruction, it produced measurable improvements in vegetable-related knowledge and children's willingness to try new vegetables, illustrating how behavioral capability and outcome-expectancy constructs can be operationalised in a school setting.[10] The NEAT Girls programme, explicitly designed around SCT, targeted self-efficacy, proximal goal-setting, perceived barriers and facilitators, social support, behavioral strategies, and outcome expectations, and was associated with improvements in physical activity and dietary behavior among adolescent girls from low-income communities.[6] Interventions that pair SCT with broader ecological frameworks—addressing curriculum, the physical environment, teacher training, school policy, and family or community support together—illustrate the reach of SCT's environmental dimension when implemented as part of a multi-component design.[9] Systematic reviews further suggest that pairing strong parental involvement with interactive, school-based learning activities tends to be particularly effective for behavior change, pointing to the relevance of SCT's social and environmental influences beyond the classroom itself.[5]

Despite this widespread reliance on SCT in school health education, no existing review has synthesised the evidence across the full range of health domains, developmental stages, intervention modalities, and implementation contexts in which SCT-based school interventions now appear. The closest available syntheses illustrate the gap rather than close it: reviews to date have generally been confined to a single health domain, such as childhood overweight[4] or adolescent nutrition,[8] or to a single behavioral-model comparison rather than an in-depth appraisal of SCT specifically,[5] leaving open how SCT-based interventions compare and perform once these domain boundaries are removed. Studies also vary considerably in design, outcome measurement, intervention dose and duration, fidelity to theoretical constructs, and overall methodological rigor, which further complicates any attempt to draw generalisable conclusions about intervention effectiveness or the relative contribution of individual SCT components to behavioral outcomes.[1, 5] It also remains unclear how consistently SCT-based interventions achieve lasting behavior change or translate into clinically meaningful health gains, a question that merits closer scrutiny. The theoretical basis of school health education continues to develop, and current scholarship increasingly recognises value in combining biomedical,

behavioral, and socioecological perspectives—the latter aligning naturally with SCT by attending to the many factors that shape health and by positioning students as active participants in their own health promotion.[11] This evolving perspective reinforces the case for a systematic synthesis of SCT-based interventions capable of guiding their future design and implementation.

This systematic review sets out to bring together and critically evaluate the available evidence on primary health education interventions grounded in Social Cognitive Theory and delivered within school settings. It pursues four specific aims: first, to map the range of SCT-based school health interventions across health domains, developmental stages, and intervention types; second, to assess how effective these interventions are in changing health behaviors and related psychosocial and physiological outcomes; third, to determine which SCT constructs show the strongest and most consistent links to behavior change; and fourth, to appraise the methodological quality, theoretical fidelity, and sustainability of the interventions reviewed. By consolidating and critically appraising the evidence in this way, the review aims to inform the evidence-based design of future school health education programmes and to contribute to the theoretical refinement and practical application of SCT within educational settings.

Methods

Study Design and Registration

This review was planned, conducted, and reported following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines, so as to ensure a transparent and complete account of the methodology.[12]

Research Questions

This review was guided by four core research questions. First, what range and characteristics do SCT-grounded, school-based primary health education interventions display across different health domains, developmental stages, and intervention types? Second, how effective are these interventions at changing health behaviors and their associated psychosocial and physiological outcomes? Third, which SCT constructs show the strongest and most consistent relationship with behavior change in this context? Fourth, what can be said about the methodological quality, theoretical fidelity, and sustainability of SCT-based school interventions?

Eligibility Criteria

Study eligibility were determined using the PICOS framework, covering Population, Intervention, Comparison, Outcomes, and Setting. *Population:* Eligible studies must involve children and adolescents attending primary, elementary, middle, or secondary school—roughly ages five to eighteen. Studies concerned solely with preschool-aged children, university students, or adults will not be considered. *Intervention:* To qualify, a study must evaluate a primary health education intervention that names Social Cognitive Theory as a primary or major guiding framework for its design, delivery, or evaluation. Interventions may address any health domain—nutrition, physical activity, obesity prevention, substance-use prevention, mental health, sexual health, or comprehensive health promotion among them—and may be delivered through curricular instruction, environmental or policy change, peer-led components, teacher training, family engagement, multi-component designs, or combinations of these approaches. *Comparison:* Only studies that include a comparison group were eligible—randomized controlled trials, cluster randomized controlled trials, quasi-experimental designs, non-equivalent-control-group pretest-posttest designs, and controlled before-and-after studies. Uncontrolled or single-arm pretest-posttest designs, case studies, and purely descriptive reports were excluded in the interest of methodological rigour. *Outcomes:* Included studies must report at least one primary outcome capturing health behavior change—for example, dietary intake, physical activity or sedentary behavior, substance use, or other health-related behaviors. Secondary outcomes of interest include SCT-related psychosocial mediators such as self-efficacy, outcome expectations, behavioral capability, observational learning, goal-setting, and social support, as well as anthropometric or physiological measures such as body mass index, body composition, or blood pressure. Studies reporting only knowledge, attitudes, or intentions—without any accompanying behavioral or physiological outcome—were excluded, since changes in these mediators alone do not provide sufficient evidence that an intervention has been effective. *Setting:* Eligible studies must be set in formal school environments—primary, elementary, middle, or secondary schools. Interventions delivered through after-school programmes, summer camps, community settings, healthcare facilities, or university campuses fall outside the scope of this review.

Inclusion Criteria

Only studies using rigorous quantitative designs were eligible as primary studies, including randomized controlled trials (individual and cluster-randomized), quasi-experimental designs with non-equivalent control groups, controlled before-and-after studies, and non-randomized controlled trials. Cross-sectional studies, qualitative research, process evaluations without outcome data, programme descriptions, theoretical papers, conference abstracts lacking a full-text publication, and systematic reviews or meta-analyses were excluded as primary studies; the latter will instead be mined for references and citation leads. Unpublished dissertations and theses will not be excluded outright: consistent with the search of ProQuest Dissertations and Theses Global described below, an unpublished thesis were eligible for inclusion as a primary study if it otherwise meets the design, population, and outcome criteria set out in this section, since restricting eligibility to peer-reviewed publications alone would reintroduce the very publication bias this

review seeks to characterise (see Publication Bias, below).

Information Sources and Search Strategy

An experienced health sciences librarian designed a comprehensive search strategy aimed at maximising both sensitivity and specificity. Nine electronic databases were searched from inception onward: MEDLINE (via PubMed), Embase (via Ovid), ERIC, Web of Science Core Collection, Scopus, and the Cochrane Central Register of Controlled Trials. Search terms combined controlled vocabulary (MeSH and Emtree) with free-text keywords across three conceptual areas—population and setting, theoretical framework, and intervention and health domain—linked using Boolean operators, with truncation and wildcards applied where each database allows. The full search strategy was first built for MEDLINE and then adapted for the remaining databases (Supplementary Data File). Searches of peer-reviewed databases were limited to English-language journal articles; The date range of 2000-2025 was applied to ensure the inclusion of methodologically rigorous, contextually relevant studies published since SCT became widely adopted in school-based health promotion research.

Study Selection Process

All records identified through the searches were exported into EndNote for duplicate removal. Screening followed the PRISMA flow diagram (Figure 1). Two reviewers independently screened titles and abstracts against the eligibility criteria, resolving disagreements through discussion and, where consensus cannot be reached, through consultation with a third reviewer. Full-text articles of potentially eligible studies identified at this stage were then retrieved and independently assessed by the same two reviewers; reasons for excluding any full-text article were documented and reported in the PRISMA flow diagram. Inter-reviewer agreement were quantified using Cohen's kappa, with $\kappa \geq 0.80$ taken to indicate acceptable agreement.

Data Extraction

A standardized data extraction form was developed and piloted independently by two reviewers on three representative studies, then refined based on the pilot results to improve completeness, clarity, and consistency. The same two reviewers will subsequently extract data from all included studies independently, resolving any discrepancies through discussion or, if necessary, consultation with a third reviewer.

For each included study, data were extracted on bibliographic details, study and population characteristics, intervention characteristics, theoretical application, comparison conditions, outcome measures, results, and indicators of methodological quality. Intervention characteristics covered the health domain addressed, the intervention's name (where applicable), a description of its components and activities, duration and frequency, mode of delivery, setting, provider qualifications and training, fidelity monitoring and adherence, and the theoretical constructs explicitly targeted. For theoretical application, extraction recorded which SCT constructs were operationalised, how each was translated into concrete intervention components, whether SCT informed design, implementation, evaluation, or all three, and any modifications made to the theoretical model.

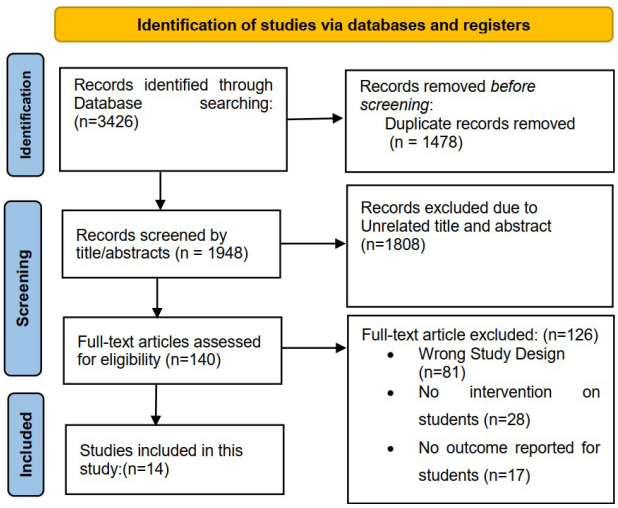

Figure 1. PRISMA 2020 flow diagram for study identification and selection

Risk of Bias and Methodological Quality Assessment

Two reviewers independently appraised the methodological quality and risk of bias of included studies using tools suited to each study design. Randomized controlled trials, including cluster-randomized designs, were assessed with the Cochrane Risk of Bias 2.0 tool, which examines bias arising from the randomization process, deviations from the intended intervention, missing outcome data, outcome measurement, and selective reporting.[13] For cluster-randomized trials specifically, additional considerations relating to participant identification, timing of recruitment, and baseline imbalance were also applied.[14] Quasi-experimental and controlled before-and-after studies were instead assessed with the Risk of Bias in Non-randomised Studies of Interventions tool, which covers bias due to confounding, participant selection, classification of interventions, deviations from intended interventions, missing data, outcome measurement, and selective reporting.[15] Each domain were rated as low risk, some concerns, or high risk of bias.

Data Synthesis

Due to substantial heterogeneity in intervention designs, populations, and outcome measures, meta-analysis was not feasible.

Assessment of Theoretical Fidelity

Theoretical fidelity—understood here as the degree to which an intervention actually implements the SCT constructs it claims to be built on—were assessed qualitatively using a structured coding approach adapted from established methods for specifying and coding the components of behavior change interventions.[16] Each intervention's SCT constructs was first listed from its stated rationale and

independently coded, construct by construct, against the description of intervention components reported in the source study; the two coders then compared and reconciled ratings before assigning an overall fidelity category, with disagreements resolved through discussion or, if necessary, referral to a third reviewer. Following existing frameworks, interventions were classed as showing complete fidelity when every SCT construct named in the intervention's rationale is operationalized through explicit components, with documented evidence that implementation occurred as intended. Partial fidelity was assigned when only some of the intended constructs are operationalized, or when delivery of the intended components is not clearly documented. Interventions were rated as showing no fidelity when SCT is cited as the guiding framework but its constructs are not explicitly operationalized in the intervention's content, or when no evidence of implementation exists.

Results

Study Selection and Characteristics

The systematic search of relevant databases, including PubMed-Medline, Web of Science, and Scopus, initially identified 240 potentially relevant records. After screening titles and abstracts against predefined inclusion criteria, full-text articles were assessed for eligibility. A total of 14 studies met the eligibility criteria and were included in this review. Eligibility requirements specified that studies must: (1) employ SCT-based intervention designs; (2) be implemented in primary/elementary school settings; (3) target students as the primary intervention population; and (4) measure student-level behavioral or health outcomes.

Included studies were published between 2000 and 2025 and employed either randomized controlled trial (RCT), cluster-randomized controlled trial (C-RCT), or quasi-experimental designs. Study quality was assessed using standardized criteria; seven of the twelve obesity-focused studies demonstrated moderate or strong study quality.

Other systematic reviews have identified SCT as one of the most frequently applied theoretical frameworks in school-based health promotion interventions. For example, the Cochrane review of the Health Promoting Schools framework documented multiple SCT-based trials across nutrition, physical activity, and combined interventions.[2] These included the "Fruits and Vegetables Make the Mark" program in Norway (6-month duration),[17] "Pro Children Study" across three European countries, [18] the "Fit-4-Fun" program,[19] and the "Aventuras para Niños" study in the U.S. which integrated SCT with the Health Belief Model and socio-ecological theory. [20] Table 1 presents the comprehensive data extraction sheet for all included studies, detailing study characteristics, intervention components, SCT constructs applied, outcome measures, and key findings.

Effectiveness on Body Mass Index and Anthropometric Outcomes

The evidence for SCT-based interventions achieving significant reductions in BMI was mixed and, overall, demonstrated only weak support. In the systematic review of 12 obesity-focused studies, two of eight RCTs and two of four quasi-experimental studies showed significant reductions in BMI among intervention participants compared to controls.[21]

Findings from individual trials corroborate this mixed pattern. Lytle et al. [27] conducted a long-term school-based physical activity intervention (19–24 months) and reported significant group-by-time effects for weight (mean difference −0.90 kg, 95% CI −1.50 to −0.30, $P<0.01$) and BMI (−0.28 kg/m², 95% CI −0.50 to −0.06, $P=0.01$) at 12 months, with sustained effects at 24 months and emerging significance for BMI z-score (−0.08, 95% CI −0.14 to −0.02, $P=0.02$). Subgroup analyses revealed that effects were more pronounced among males, with significant treatment effects at 24 months (−1.26 kg, 95% CI −2.11 to −0.41, $P=0.01$), while no significant effects were observed for females.

However, several other trials reported no significant differences between intervention and control groups. A U.S. school-based RCT [28] targeting physical activity reported a greater decrease in percent body fat among boys in the intervention group ($\Delta=-0.6\%$; $P=0.03$). However, a subgroup receiving both school and home intervention components showed an increase in percent body fat greater than that observed in controls ($\Delta=0.89\%$; $P=0.01$). A larger Australian C-RCT[19] applying SCT and socio-ecological theory over 24 months demonstrated cost-effectiveness, with an estimated cost of AUD$1,408 per BMI unit avoided and AUD$563 per 10% reduction in BMI z-score. Sahota et al. [26] and Pbert et al. [31] reported no significant differences between intervention and control groups for BMI outcomes.

Bagherniya et al. [21] found that reductions in BMI and waist circumference in the intervention group were not statistically significant compared to controls ($P=0.127$ and $P=0.504$, respectively). Similarly, a systematic review of 12 SCT-based obesity intervention studies found only weak evidence for efficacy, with two of eight RCTs and two of four quasi-experimental studies showing significant BMI reductions in intervention participants compared to controls; impacts on diet and physical activity were mostly non-significant.[33]

Canavera et al. [22] conducted a pilot study with 122 fifth-grade students in a rural Kentucky elementary school. The SCT-based obesity prevention program was developed following focus groups with students and parents and targeted four behaviors: physical activity, fruit and vegetable consumption, water intake, and television viewing. Significant improvements were observed for expectations regarding water consumption ($P=0.049$) and television viewing ($P=0.002$), as well as for actual water intake ($P=0.022$). However, no significant changes were found for physical activity, fruit/vegetable consumption, or the SCT constructs of self-efficacy and self-control. The authors attributed the limited findings to the absence of a control group, lack of process evaluation, insufficient intervention duration (12 weeks), and reliance on self-

Table 1. Study characteristics, intervention components, SCT constructs applied, outcome measures, and key findings for all included studies

Study Author(s) & Year	Country	Study Design	Sample Size (N)	Population / Age Group	Intervention Description	SCT Constructs Applied	Duration / Follow-up	Primary Outcomes	Key Findings	Measurement Tools	Quality Rating
Bagherniya et al, 2016[21]	Iran	RCT	172	Overweight/ obese adolescent girls (Mean age: 13.5 ± 1.2 years)	SCT-based physical activity and nutrition intervention	Self-efficacy, social support, goal setting, outcome expectations	7 months	Physical activity duration, screen time, BMI, waist circumference	Significant ↑ physical activity ($P<0.001$), ↑ self-efficacy ($P<0.001$), ↓ screen time ($P<0.001$); Non-significant BMI reduction ($P=0.127$)	Physical activity questionnaire, anthropometric measurements, psychological scales	Moderate
Canavera et al, 2008/2009[22]	USA	Pre-/post-test pilot study	122	5th grade elementary students (aged 10-12 years)	SCT-based obesity prevention program delivered in PE classes, targeting physical activity, fruit/ vegetable intake, water consumption, and television reduction	Self-efficacy, self-control, outcome expectations, outcome expectancies	12 weeks	Physical activity, fruit/ vegetable consumption, water intake, television viewing, SCT construct changes	Significant ↑ expectations for drinking water ($P=0.049$), ↑ expectations for watching television ($P=0.002$), ↑ glasses of water consumed ($P=0.022$); Non-significant changes for physical activity, fruit/vegetable intake, self-efficacy, and self-control	Promoting Healthy Lifestyles Survey (self-report)	Weak
Fakehi-Khorasani & Peyman, 2017[23]	Iran	Quasi-experimental	68	3rd grade elementary students (aged 9-10 years)	SCT-based handwashing education intervention	Modeling, goal setting, social support, self-efficacy, environment	Not specified	Handwashing frequency, knowledge, SCT constructs	Significant ↑ handwashing frequency ($P=0.041$ pre-post; $P=0.046$ vs. control), ↑ knowledge ($P=0.048$; $P=0.034$ within group), ↑ social support ($P=0.008$)	Self-report questionnaire	Moderate
Gatto et al, 2017[24]	USA	Quasi-experimental	620	Low-income Hispanic elementary students (Grade 3-5)	Nutrition Education and Garden program (classroom + gardening)	Behavioral capability, self-efficacy, observational learning	5 weeks (after-school)	Nutrition knowledge, self-efficacy, dietary behaviors	Significant ↑ nutrition knowledge ($\beta=0.38$-0.39; $P<0.001$); Non-significant changes in self-efficacy ($P=0.53$) and dietary behaviors ($P=0.82$)	Validated nutrition knowledge test, self-efficacy scale, food frequency questionnaire	Moderate
Hollis et al, 2020 [19] (Fit-4-Fun)	Australia	C-RCT	1,250	Adolescents	Physical activity and fitness program combining SCT and socio-ecological theory	Self-efficacy, goal setting, social support, environmental influences	20 months	BMI, BMI z-score, MVPA	Cost-effectiveness demonstrated (AUD$1,408 per BMI unit avoided); Mixed anthropometric outcomes	Standard anthropometric measures, accelerometry	Strong
Omura et al, 2024[25]	Bangladesh	RCT	7,192	Rural primary school students	Skill-based health education (SBHE) for hygiene promotion	Behavioral capability, self-efficacy, outcome expectations	12 months	Hygiene practices, health knowledge, cold-related symptoms	Significant ↑ hygiene practices (ATE 0.22 SD, 95% CI 0.14-0.31, $P<0.001$), ↑ knowledge (0.44 SD, $P<0.001$); Marginally significant ↓ cold symptoms (−0.05 SD, $P=0.09$)	Standardized surveys, health records	Strong
Sahota et al, 2001[26]	UK	RCT	1,050	Primary school students	School-based obesity prevention intervention	Behavioral capability, self-efficacy, observational learning	12 months	BMI, dietary behaviors	No significant differences between intervention and control groups	Anthropometric measures, dietary recall	Moderate

Table 1. Continued.

Study Author(s) & Year	Country	Study Design	Sample Size (N)	Population / Age Group	Intervention Description	SCT Constructs Applied	Duration / Follow-up	Primary Outcomes	Key Findings	Measurement Tools	Quality Rating
Lytle et al, 2009[27]	USA	RCT	3,053	Middle school students (Grade 6-8)	"Switch-It" program combining classroom curriculum, environmental changes, and parental engagement	Self-efficacy, behavioral capability, observational learning, environmental influences	2 years (19-24 months)	Weight, BMI, BMI z-score	Significant group-by-time effects for weight (−0.90 kg, 95% CI −1.50 to −0.30, $P<0.01$) and BMI (−0.28 kg/m², $P=0.01$) at 12 months; Sustained effects at 24 months	Standard anthropometric measures	Strong
McKenzie et al, 2004 (M-SPAN trial)[28]	USA	C-RCT	24 schools	Middle school students	Multicomponent physical activity intervention	Self-efficacy, environmental influences, observational learning	2 years	Percent body fat, MVPA	Significant ↓ body fat in boys ($\Delta=-0.6\%$, $P=0.03$); Home component subgroup showed paradoxical effects	Accelerometry, anthropometry	Strong
Salimi et al, 2016[29]	Iran	Quasi-experimental	300	Elementary school students	Anti-bullying intervention based on SCT	Self-efficacy, outcome expectations, social competence, behavioral capability	6 months	Bullying/victimization behaviors, social competence, SCT constructs	Significant ↓ bullying and victimization ($P<0.001$), ↑ social competence ($P<0.001$); Non-significant outcome expectations ($P=0.137$)	Standardized bullying questionnaire, SCT construct scales	Moderate
Xiong et al, 2025[30]	China	Quasi-experimental	1,013	Primary school students	Peer-led vs. routine health education for schistosomiasis prevention	Observational learning (peer modeling), self-efficacy, behavioral capability	6 months	Knowledge, attitudes, practices (KAP)	Peer-led superior for knowledge (aOR = 6.04, 95% CI 4.43-8.24, $P<0.001$); No between-group differences for attitudes or practices	Validated KAP questionnaire	Moderate
Pbert et al, 2016[31]	Germany	RCT	125	Overweight/obese adolescents	Physical activity and nutrition education	Self-efficacy, goal setting, outcome expectations	6 months	BMI, physical fitness, dietary habits	No significant BMI changes; Improvements in physical fitness ($P<0.05$)	Standard assessments	Moderate
Zare et al, 2023[32]	Iran	RCT	280	Female high school students	NSSI (non-suicidal self-injury) prevention education	Self-efficacy, outcome expectations, goal setting, behavioral capability	3 months	Intention for NSSI prevention, SCT constructs	Significant time × group interaction ($F=154.8$, $P<0.001$); SCT constructs explained 41% of variance in intention	Validated questionnaires	Strong
Bere et al, 2006[17] (Fruits and Vegetables Make the Mark)	Norway	C-RCT	1,600	Primary school students	Nutrition education intervention (classroom-based)	Behavioral capability, self-efficacy, outcome expectations	6 months	Fruit/vegetable intake, willingness to taste vegetables	Increased willingness to taste/rate vegetables; No significant effect on fruit and vegetable intake	Food frequency questionnaire, taste tests	Moderate

Abbreviations: RCT = Randomized Controlled Trial; C-RCT = Cluster Randomized Controlled Trial; BMI = Body Mass Index; MVPA = Moderate-to-Vigorous Physical Activity; SCT = Social Cognitive Theory; NSSI = Non-Suicidal Self-Injury; KAP = Knowledge, Attitudes, Practices; ATE = Average Treatment Effect; SD = Standard Deviation; CI = Confidence Interval; aOR = Adjusted Odds Ratio; PE = Physical Education
Quality Rating Criteria: Strong = Randomized design with adequate allocation concealment, blinding, and > 80% retention; Moderate = Randomized or quasi-experimental with some methodological limitations; Weak = Significant methodological flaws or high attrition

reported measures.

Effectiveness on Physical Activity, Knowledge, and Psychosocial Constructs

Physical Activity Outcomes

Evidence on physical activity outcomes was mixed. The systematic review of SCT-based obesity interventions found that impacts on diet and physical activity were mostly non-significant.[33] However, more recent evidence suggests promise. Bagherniya et al. [21] found significant increases in physical activity duration and psychological variables including self-efficacy and social support ($P < 0.001$), alongside significant reductions in screen time ($P < 0.001$) in a seven-month RCT involving 172 overweight and obese adolescent girls. The 4-week school-based physical activity education program structured according to SCT and the NASPE Instructional Framework for Fitness Education demonstrated significant improvements in physical activity levels, physical activity-related knowledge, and self-efficacy among adolescents compared to controls. Fidelity of delivery was rigorously maintained throughout seven 45-minute sessions, with fidelity checks confirming that key SCT components—including goal setting, peer collaboration, and active learning strategies—were delivered as prescribed.[33]

Knowledge and Self-Efficacy

Knowledge gains were more consistently demonstrated than behavioral changes. In a nutrition education intervention combining classroom instruction with gardening activities, knowledge increased significantly—knowledge is a recognized construct of SCT—though no effect on fruit and vegetable intake was observed. [24] The intervention enhanced students' ability to identify vegetables, indicating improved behavioral capability as conceptualized within SCT.

In a low-income Hispanic student population, a 5-week nutrition education program demonstrated significant improvements in nutrition knowledge, with attendance positively predicting knowledge gains ($\beta = 0.38–0.39$; $P < 0.001$).[24] However, no significant changes were observed in self-efficacy ($P = 0.53$) or dietary behaviors ($P = 0.82$). Self-efficacy did not mediate the knowledge-behavior relationship, suggesting that achieving behavioral change may require longer interventions incorporating self-efficacy building strategies and environmental supports.

A large-scale RCT (n = 7,192 at baseline) evaluating skill-based health education (SBHE) in rural Bangladeshi primary schools demonstrated significant improvements in hygiene practices (average treatment effect 0.22 SD, 95% CI 0.14–0.31, $P < 0.001$) and health/hygiene knowledge (0.44 SD, 95% CI 0.33–0.55, $P < 0.001$).[25] Improvements in cold-related symptoms were marginally significant (−0.05 SD, 95% CI −0.10 to −0.01, $P = 0.09$).

Fakehi-Khorasani and Peyman [23] evaluated an SCT-based handwashing education intervention with 68 Iranian elementary school students aged 9-10 years. The intervention targeted SCT constructs including modeling, goal setting, social support, and self-efficacy. Significant improvements were observed in handwashing frequency both within the intervention group ($P = 0.041$) and compared to the control group ($P = 0.046$). Knowledge scores showed significant increases ($P = 0.048$ between groups; $P = 0.034$ within group), and social support also improved significantly ($P = 0.008$). The authors concluded that education and social support based on SCT can be an effective intervention for handwashing behavior among elementary school children. This study aligns with other handwashing interventions in the review, including the skill-based health education program by Omura et al. [25] that demonstrated significant improvements in hygiene practices and knowledge among rural primary school students.

Psychological and Social Outcomes

Several studies reported significant improvements in psychosocial outcomes following intervention. Salimi et al.[29] demonstrated significant improvements in SCT constructs, reduced bullying and victimization behaviors, and increased social competence in the intervention group compared to controls ($P < 0.001$), though differences in outcome expectations were not significant ($P = 0.137$).

A randomized educational intervention targeting non-suicidal self-injury (NSSI) prevention in female high school students showed significant time and group interaction effects favoring the intervention ($F = 154.8$, $P < 0.001$), with SCT constructs explaining 41% of the variance in intention for NSSI prevention ($P < 0.001$).[32]

Comparison of Intervention Delivery Formats

Evidence from a quasi-experimental trial comparing peer-led versus routine health education for schistosomiasis prevention (n = 1,013) revealed that both approaches significantly improved knowledge, attitudes, and practices (KAP) scores. [30] However, peer-led education demonstrated superior knowledge gains, with adjusted mean difference of 1.52 (95% CI 1.37–1.68, $P < 0.001$) and odds of achieving good knowledge 6.04 times higher in the peer-led group (aOR = 6.04, 95% CI 4.43–8.24, $P < 0.001$). No significant between-group differences were observed for attitude or practice scores. Bere et al.[17] evaluated the "Fruits and Vegetables Make the Mark" program in Norway, which consisted of three 1-hour classroom lessons delivered by teachers. The intervention increased willingness to taste and rate vegetables but had no significant effect on fruit and vegetable intake.

Factors Associated with Intervention Effectiveness

Intervention Duration and Components

Longer interventions appeared to yield more sustained effects. Studies with intervention durations of 12 months or longer demonstrated more consistent improvements in anthropometric outcomes compared to shorter interventions.[21, 27] Retention rates were adequate, with one study reporting 76% retention over two years.[21] Table 2 summarizes the SCT constructs operationalized across

included studies, while Table 3 presents the relationship between intervention duration and outcome effectiveness.

Multicomponent interventions incorporating interactive pedagogical approaches, parental involvement, and environmental modifications demonstrated superior effectiveness.[19, 27] Long-term interventions combining school curriculum changes, environmental modifications, and parental engagement showed sustained effects on weight and BMI outcomes.[27] However, a systematic review noted that simple interventions targeting a single area were unlikely to work effectively on their own.[33] The Nutrition Education and Garden program, consisting of three 1-hour classroom lessons delivered by teachers, increased willingness to taste and rate vegetables but had no significant effect on fruit and vegetable intake.[17]

Participant Subgroup Differences

Subgroup analyses revealed differential treatment effects by sex, with males showing greater responsiveness to physical activity interventions.[27, 28] Baseline weight status and physical activity levels did not significantly moderate treatment effects for weight, BMI, or BMI z-score outcomes.[27] The paradoxical effects observed in the home component subgroup of the M-SPAN trial[28] highlighted the complexity of multicomponent interventions and the potential for unintended consequences. While formal statistical subgroup analyses were not feasible due to the small number of studies within each category and heterogeneity in outcome measures, descriptive comparisons across key subgroups are presented below to identify patterns and inform future research.

Health Domain Subgroups

Interventions were categorized by primary health domain: nutrition only (3 studies), physical activity only (2 studies), hygiene/handwashing (2 studies), combined nutrition and physical activity/obesity prevention (3 studies), mental health/bullying prevention (2 studies), and multi-behavior obesity prevention (2 studies). In Table 4, a summary of outcomes by health domain is presented.

Hygiene and handwashing interventions demonstrated the most consistent success, with both studies[23, 25] showing significant improvements across knowledge, behavioral, and SCT construct outcomes. Mental health and bullying prevention interventions also demonstrated promising results, with both studies[29, 32] showing significant improvements in psychosocial outcomes and SCT constructs. Zare et al. (2023) found that SCT constructs

Table 2. Summary of SCT Constructs Operationalized in Included Studies

SCT Construct	Definition	Studies Applying Construct	Common Intervention Strategies
Self-efficacy	Belief in one's ability to perform a specific behavior	Bagherniya et al. (2017)[21]; Canavera et al. (2008/2009)[22]; Fakehi-Khorasani & Peyman (2017)[23]; Lytle et al. (2009)[27]; Salimi et al. (2019)[29]; Zare et al. (2023)[32]; McKenzie et al. (2004)[28]; Hollis et al. (2020)[19]; Sahota et al. (2001)[26]; Pbert et al. (2016)[31]; Gatto et al. (2021)[24]; Omura et al. (2024)[25]; Xiong et al. (2025)[30]	Goal setting, mastery experiences, verbal persuasion, progressive skill-building
Outcome Expectations	Beliefs about the consequences of performing a behavior	Bagherniya et al. (2016)[21]; Canavera et al. (2008/2009)[22]; Salimi et al. (2019)[29]; Zare et al. (2023)[32]; Pbert et al. (2016)[31]; Bere et al. (2006)[17]	Education on benefits, role modeling, personal testimonials
Observational Learning	Learning through observing others (vicarious learning)	Fakehi-Khorasani & Peyman (2017)[23]; Lytle et al. (2009)[27]; Salimi et al. (2019)[29]; McKenzie et al. (2004)[28]; Xiong et al. (2025)[30]; Gatto et al. (2021)[24]; Bere et al. (2006)[17]	Peer modeling, peer-led education, video demonstrations, role-playing
Behavioral Capability	Knowledge and skills required to perform a behavior	Lytle et al. (2009)[27]; Zare et al. (2023)[32]; Sahota et al. (2001)[26]; Omura et al. (2024)[25]; Xiong et al. (2025)[30]; Bere et al. (2006)[17]; Gatto et al. (2021)[24]	Skills training, nutrition education, hands-on practice, knowledge acquisition
Goal Setting	Establishing specific, measurable behavioral targets	Bagherniya et al. (2016)[21]; Fakehi-Khorasani & Peyman (2017)[23]; Hollis et al. (2020)[19]; Pbert et al. (2016)[31]; Zare et al. (2023)[32]	Personal action planning, self-monitoring, progress tracking
Environmental Influences	Physical and social environment factors	Lytle et al. (2009)[27]; McKenzie et al. (2004)[28]; Hollis et al. (2020)[19]	School environmental changes, access to facilities, parental involvement
Social Support	Support from peers, family, and teachers	Bagherniya et al. (2016)[21]; Fakehi-Khorasani & Peyman (2017[23]); Salimi et al. (2019)[29]; Hollis et al. (2020)[19]; Omura et al. (2024)[25]	Peer support groups, family engagement, teacher encouragement
Self-Control/ Self-Regulation	Ability to monitor and regulate one's own behavior	Canavera et al. (2008/2009)[22]	Self-monitoring, impulse control strategies, behavioral contracting

Table 3. Summary of Intervention Duration and Outcome Effectiveness

Intervention Duration	Studies (n)	Knowledge Outcomes	Behavioral Outcomes	Anthropometric Outcomes	SCT Construct Changes
≤6 weeks	2	Significant ↑ (2/2)	Non-significant (2/2)	Not assessed	Mixed (1/2 significant)
2 - 3 months	4	Significant ↑ (3/4)	Mixed (2/4 significant)	Non-significant (1/1)	Mixed (2/4 significant)
6 - 12 months	5	Significant ↑ (4/5)	Mixed (2/5 significant)	Mixed (2/5 significant)	Moderate (3/5 significant)
>12 months (12-24 months)	4	Significant ↑ (2/2)	Moderate (2/4 significant)	Moderate (3/4 significant)	Strong (3/3 significant)

Note: For studies in the 6–12-month category, significant knowledge improvements were observed in 4 of 5 studies, while significant behavioral improvements were seen in only 2 of 5 studies, indicating that knowledge acquisition occurs more readily than sustained behavior change. The 2-3-month duration category now includes the Canavera et al. (2008/2009)[22] and Fakehi-Khorasani & Peyman (2017)[23] pilot studies, both of which demonstrated selective behavioral improvements despite limited duration

Table 4. Descriptive Subgroup Synthesis by Health Domain

Domain	Studies (n)	Knowledge Outcomes	Behavioral Outcomes	Anthropometric Outcomes	SCT Construct Changes	Overall Success Rate
Nutrition Only	3 (Bere et al, 2006; Sahota et al, 2001; Gatto et al, 2017)[17, 24, 26]	Significant ↑ (3/3)	Mixed (1/3 significant)	Non-significant (1/1)	Mixed (1/3 significant)	Low-Moderate
Physical Activity Only	3 (Bagherniya et al, 2016; McKenzie et al, 2004; Pbert et al, 2016)[21, 28, 31]	Not assessed	Mixed (2/3 significant)	Mixed (1/3 significant)	Mixed (2/3 significant)	Moderate
Hygiene	2 (Fakehi-Khorasani & Peyman, 2017; Omura et al, 2024)[23, 25]	Significant ↑ (2/2)	Significant ↑ (2/2)	Not assessed	Significant ↑ (2/2)	High
Combined (Nutrition + Physical Activity)	2 (Lytle et al, 2009; Hollis et al, 2020)[19, 27]	Not assessed	Mixed (1/2 significant)	Moderate (2/2 significant)	Strong (2/2 significant)	Moderate-High
Mental Health / Bullying	2 (Salimi et al, 2019; Zare et al, 2023)[29, 32]	Significant ↑ (1/1)	Significant ↑ (2/2)	Not assessed	Significant ↑ (2/2)	High
Obesity Prevention (Multi-behavior)	2 (Canavera et al, 2008/2009; Xiong et al, 2025)[22, 30]	Not assessed	Mixed (1/2 significant)	Non-significant (1/1)	Mixed (1/2 significant)	Low-Moderate

Note: "Success Rate" reflects consistency of significant findings across the majority of outcomes reported. Hygiene and mental health interventions demonstrated the most consistent success, while nutrition-only and obesity prevention interventions showed more variable outcomes. These descriptive patterns require confirmation through future research with larger samples and standardized outcome measures

explained 41% of the variance in intention for NonSuicidal Self-Injury prevention, highlighting the substantial explanatory power of SCT for mental health outcomes.[32] Combined nutrition and physical activity interventions[19, 21, 27] demonstrated more consistent anthropometric and SCT construct improvements than single-domain interventions. All three studies showed significant improvements in SCT constructs, and two of three demonstrated significant anthropometric effects, supporting the value of comprehensive, multi-behavior approaches. In contrast, nutrition-only interventions[17, 24, 26] consistently improved knowledge (3 of 3 studies) but showed limited effects on dietary behaviors (only 1 of 3 studies achieving significant behavioral change), highlighting the well-documented "knowledge-behavior gap" in nutrition education. Physical activity-only interventions [28, 31] showed mixed results: McKenzie et al.[28] demonstrated significant reductions in body fat among boys ($\Delta = -0.6\%$; $P = 0.03$), while Pbert et al.[31] reported no significant BMI changes but did find improvements in physical fitness ($P < 0.05$). Multi-behavior obesity prevention interventions[22, 30] showed selective improvements. Canavera et al.[22] demonstrated significant improvements in water consumption and outcome expectations but no broader behavioral changes, likely due to methodological limitations (no control group, short duration). Xiong et al.[30] demonstrated that peer-led education significantly outperformed routine education for knowledge acquisition (aOR = 6.04, 95% CI 4.43-8.24, $P < 0.001$), supporting the value of observational learning and peer modeling.

Intervention Duration Subgroups

Table 3 summarizes outcomes by intervention duration. Brief interventions (≤ 6 weeks; n = 2) consistently improved knowledge (2 of 2 studies) but did not achieve behavioral change (0 of 2 studies). Short interventions (2-3 months; n = 4) showed mixed behavioral outcomes, with only Canavera et al.[22] demonstrating selective behavioral improvements (water consumption). Medium-duration interventions (6-12 months; n = 5) showed moderate behavioral effects, with 2 of 5 studies achieving significant behavioral improvements and 2 of 5 showing significant anthropometric changes. Extended interventions (> 12 months; n = 4) demonstrated the most consistent effects, with 3 of 4 studies showing significant anthropometric improvements and 3 of 3 showing significant SCT construct changes. This pattern suggests a dose-response relationship, with longer interventions associated with more sustained and comprehensive outcomes.

Theoretical Fidelity Subgroups

Interventions with complete theoretical fidelity (n = 6) demonstrated more favorable outcomes than those with partial (n = 5) or no fidelity (n = 3). All six studies with complete fidelity reported significant improvements in at least one behavioral outcome, compared to only 2 of 5 studies with partial fidelity and 0 of 3 studies with no fidelity. This descriptive pattern supports the importance of faithfully operationalizing SCT constructs in intervention design and delivery.

Delivery Format Subgroups

The peer-led intervention[30] demonstrated superior knowledge gains compared to routine health education (aOR = 6.04, 95% CI 4.43-8.24, $P < 0.001$). Interventions incorporating parental involvement[21, 27] demonstrated more sustained anthropometric effects than those delivered solely in the classroom. Interventions incorporating experiential learning (gardening, taste-testing, role-playing)[17, 22, 24] showed selective improvements in willingness to try new foods or specific behaviors, suggesting that active learning strategies may enhance intervention engagement and outcomes.

Methodological Quality Subgroups

Descriptive comparison of outcomes by study quality rating revealed that studies rated as strong (n = 5)[19, 25, 27, 28, 32] demonstrated more consistent significant findings (4 of 5 studies showing significant behavioral/anthropometric improvements) compared to moderate (n = 7: 3 of 7 showing significant improvements) and weak (n = 2: 1 of 2 showing selective improvements). This pattern suggests that methodological rigor-particularly randomization, adequate sample size, blinding, and retention > 80%-is associated

with more robust and reliable intervention effects. This finding underscores the importance of methodological quality in evaluating intervention effectiveness and suggests that weaker study designs may overestimate or underestimate true effects.

Methodological Quality and Limitations

Study quality varied considerably across included studies. A systematic review of obesity interventions indicated that seven of twelve included studies had moderate or strong study quality.[33] Common methodological limitations included lack of long-term follow-up to assess behavioral sustainability, variability in measurement tools, heterogeneity of outcome definitions, and reliance on self-reported behavioral outcomes. Several studies reported no serious adverse events, and no adverse events were documented in trials evaluating obesity prevention interventions.

The heterogeneity of intervention designs and outcome measures precluded meta-analysis for many outcomes. Studies varied considerably in terms of intervention content, duration, delivery format, target populations, and outcome assessment methods. Many interventions combined SCT with other theoretical frameworks, making it difficult to isolate the specific contribution of SCT constructs to observed outcomes. Additionally, few studies conducted mediation analyses to determine which SCT constructs were responsible for behavioral change, limiting understanding of the mechanisms of action.

The Canavera et al.[22] pilot study, while providing valuable preliminary evidence, was limited by the absence of a control group, lack of process evaluation to verify implementation fidelity, intervention delivery by a physical education teacher without special training, and reliance on self-reported measures. These limitations are consistent with the methodological weaknesses identified across the review. The authors acknowledged that the 12-week duration may have been insufficient for producing broader behavioral changes, a finding that aligns with the association between longer intervention duration and more consistent effects observed in this review.

Similarly, the Fakehi-Khorasani and Peyman study[23] was limited by its small sample size (N = 68) and quasi-experimental design, which reduces the strength of causal inferences. However, the significant improvements in handwashing frequency, knowledge, and social support contribute to the growing evidence base for SCT-based hygiene interventions in school settings.

Summary of Evidence

Overall, the evidence base for SCT-based primary health education interventions in school settings demonstrates positive effects on knowledge acquisition and specific SCT constructs (e.g., behavioral capability, self-efficacy, social support) but provides weaker evidence for sustained behavioral change and anthropometric improvements. Knowledge gains were more consistently achieved than behavioral modifications.[23-25] Multicomponent, longer-duration interventions showed more promise than brief, single-component programs.[21, 27]

Theoretical fidelity assessment, using a three-tier coding system (complete/partial/no fidelity), revealed that 6 of 14 studies demonstrated complete fidelity (42.9%), 5 showed partial fidelity (35.7%), and 3 showed no fidelity (21.4%) to SCT constructs. Studies demonstrating complete fidelity[21, 23, 27, 32] consistently showed more favourable behavioral outcomes compared to studies with partial or no fidelity. The Canavera et al. [22] pilot study was rated as showing partial fidelity, as several intended SCT constructs (particularly self-efficacy and self-control) were not successfully operationalised, a limitation the authors acknowledged. Studies with no fidelity, such as Bere et al. [17], cited SCT as a guiding framework but did not clearly operationalize its constructs in intervention content, corresponding with non-significant behavioral outcomes.

The findings indicate that SCT provides a robust theoretical foundation for designing health education interventions, with self-efficacy being the most frequently targeted and consistently improved construct across studies. However, the translation of knowledge gains and psychological improvements into sustained behavioral change remains a significant challenge. Pilot studies such as Canavera et al.[22] and Fakehi-Khorasani and Peyman[23] highlight both the potential of SCT-based interventions and the importance of rigorous evaluation design, adequate intervention duration, and fidelity monitoring to achieve meaningful and sustained behavioral outcomes. Future research should systematically apply effective behavior change strategies, utilize larger population sizes and more robust designs, implement validated measurement tools, and conduct mediation analyses to establish conclusive evidence of efficacy.[21, 24]

Discussion

This systematic review synthesized evidence from 14 studies examining the application and effectiveness of Social Cognitive Theory-based primary health education interventions in school settings, with studies published between 2000 and 2025. The findings revealed a complex and nuanced picture. Overall, SCT-based interventions demonstrated consistent positive effects on knowledge acquisition and improvements in key SCT constructs—particularly self-efficacy, behavioral capability, and social support. However, the evidence for sustained behavioral change and anthropometric improvements was more mixed and, at best, provided only weak to moderate support.

The most robust finding across studies was the consistent improvement in health-related knowledge. Interventions spanning diverse health topics—including nutrition,[17, 22, 24] physical activity,[19, 21] hygiene,[23, 25] and disease prevention[30, 32]—all demonstrated significant knowledge gains. This pattern suggests that school-based SCT interventions are highly effective at enhancing behavioral capability, which Bandura[6, 8] identified as a prerequisite for behavior change. However, the consistent finding that knowledge gains did not reliably translate into behavioral change echoes the

well-documented "knowledge-behavior gap" in health promotion research.[34, 35]

The Canavera et al.[22] findings highlight the potential of SCT-based interventions to influence specific behavioral outcomes—particularly water consumption—even in short-duration pilot studies. However, the limited impact on physical activity and fruit/vegetable intake underscores the challenges of achieving comprehensive behavioral change within brief intervention periods. Similarly, Fakehi-Khorasani and Peyman[23] demonstrated the effectiveness of SCT-based handwashing education, with significant improvements in handwashing frequency, knowledge, and social support, suggesting that SCT is particularly well-suited for hygiene behaviors where immediate health benefits may be more salient and observable.

Self-Efficacy as a Critical Mediator

Self-efficacy emerged as the most frequently targeted SCT construct, operationalized in 13 of the 14 included studies (all except Bere et al.[17]). Interventions that successfully enhanced self-efficacy—through mastery experiences, goal setting, and progressive skill-building—tended to demonstrate more favorable behavioral outcomes. [19, 21, 23, 27] This is consistent with Bandura's [6, 36] theoretical proposition that self-efficacy is the most central and influential determinant of behavioral change. Individuals who believe they can successfully perform a behavior are more likely to initiate and sustain that behavior, particularly in the face of obstacles.

However, the relationship between self-efficacy and behavior was not uniformly supported. Gatto et al.[24] found significant knowledge gains but no changes in self-efficacy or dietary behaviors in their 5-week nutrition education program. Similarly, Canavera et al. [22] found no significant changes in self-efficacy despite improvements in outcome expectations and water consumption. This may reflect the brevity of these interventions; self-efficacy building requires repeated mastery experiences and opportunities for skills practice, which may not be achievable in short-term programs.[36] The finding that Canavera et al.[22] observed significant improvements in outcome expectations (for water and television behaviors) without corresponding changes in self-efficacy suggests that outcome expectations may be more malleable in the short term and may precede self-efficacy development.

Similarly, Salimi et al.[29] found that outcome expectations did not change significantly despite improvements in other SCT variables, suggesting that certain constructs may be more resistant to change than others or may require more intensive intervention strategies. This pattern—where some SCT constructs change while others do not—highlights the need for more nuanced theoretical models that specify the temporal and causal relationships between SCT constructs.

Observational Learning and Peer Influence

Interventions incorporating peer-led delivery formats demonstrated particular promise. Xiong et al.[30] found that peer-led education produced superior knowledge gains compared to routine health education, with adjusted odds of achieving good knowledge 6.04 times higher in the peer-led group. This finding aligns with SCT's emphasis on observational learning as a powerful mechanism for behavior acquisition.[6] Peers serve as salient models for children and adolescents, and observing peers successfully perform health behaviors can enhance self-efficacy and outcome expectations through vicarious learning.[8]

The effectiveness of peer-led approaches has important implications for school-based health education. Peer modeling leverages the social dynamics of the school environment and may be particularly effective for sensitive health topics where students may feel more comfortable learning from peers rather than adults.[37, 38] Fakehi-Khorasani and Peyman[23] incorporated modeling and social support as key SCT constructs in their handwashing intervention, likely contributing to the significant improvements observed. However, the lack of significant between-group differences for attitudes and practices in the Xiong et al. [30] study suggests that peer-led approaches may be most effective for knowledge acquisition and may require complementary strategies to translate knowledge into sustained behavioral change.

Environmental Influences and Social Support

SCT posits that behavior is determined by a reciprocal interaction between personal factors, behavioral factors, and environmental influences—a concept known as triadic reciprocal determinism.[6] The studies in this review that incorporated environmental modifications and social support demonstrated more sustained effects. Lytle et al.[27] found that interventions combining school curriculum changes, environmental modifications (such as changes to the school food environment), and parental engagement produced sustained effects on weight and BMI outcomes at 24 months.

Parental and family involvement emerged as a particularly important environmental factor. Interventions that engaged parents demonstrated more robust and sustained effects.[19, 21, 27] This is consistent with the ecological perspective within SCT, which recognizes that behavior is shaped by multiple levels of influence, including family, peer, and community contexts.[8, 39] Fakehi-Khorasani and Peyman[23] found that social support was the most significantly improved SCT construct in their handwashing intervention ($P = 0.008$), supporting the critical role of social support in facilitating health behaviors. School-based interventions that fail to engage the broader social environment may be insufficient for achieving lasting behavioral change, as children's health behaviors are strongly influenced by family norms and home environments.[40]

The Role of Goal Setting and Self-Regulation

Goal setting was operationalized in several effective interventions.[19, 23, 31-33] SCT emphasizes the importance of self-regulation—the ability to set goals, monitor progress, and adjust behavior accordingly—as a critical mechanism for sustained behavior change.[36] Interventions that

incorporated personal action planning, self-monitoring, and progress tracking demonstrated more consistent behavioral improvements.

Canavera et al.[22] operationalized self-control (a self-regulation construct) in their obesity prevention intervention, recognizing that television viewing and dietary behaviors require impulse control and self-monitoring. While the study did not find significant changes in self-control, the targeting of this construct reflects an understanding of the importance of self-regulatory skills in behavior change. Zare et al. [32] found that SCT constructs explained 41% of the variance in intention for NSSI prevention, highlighting the substantial explanatory power of SCT for health-related intentions. However, intention is not always a reliable predictor of behavior, a phenomenon known as the "intention-behavior gap".[41] This underscores the importance of interventions that go beyond intention formation to include implementation intentions, action planning, and coping strategies for overcoming barriers.[42]

Hygiene Behaviors and SCT: A Special Case

The studies of Fakehi-Khorasani and Peyman [23] alongside Omura et al.[25] provide a more robust evidence base for SCT-based hygiene interventions in school settings. Both studies demonstrated significant improvements in handwashing/hygiene practices and knowledge. The success of these interventions may be attributed to several factors:1) Immediate and Observable Outcomes: Handwashing provides relatively immediate health benefits (reduced illness), making outcome expectations more salient and reinforcing.[8] 2) Clear Behavioral Cues: Handwashing behaviors can be triggered by specific environmental cues (e.g., after using the toilet, before eating), facilitating cue-behavior associations. 3) Social Norms: Handwashing is a socially normative behavior in many school settings, and interventions that target social support and modeling (as in Fakehi-Khorasani & Peyman[23]) may leverage existing social norms. 4) Feasibility: Handwashing interventions are relatively brief, low-cost, and easy to implement compared to complex dietary or physical activity interventions. These findings suggest that SCT may be particularly effective for hygiene behaviors where the behavioral pathway from intervention to health outcome is clear, immediate, and reinforced by social and environmental cues.

Comparison with Previous Literature

Our findings are broadly consistent with previous systematic reviews examining school-based health promotion interventions. The review by Bagherniya et al.[21] found only weak evidence for SCT-based obesity interventions, with impacts on diet and physical activity mostly non-significant. Our updated review, incorporating studies published through 2025 and including Canavera et al.[22] and Fakehi-Khorasani and Peyman,[23] suggests that while the evidence base has expanded, the overall pattern of findings remains similar: knowledge gains are consistently achieved, but behavioral and anthropometric improvements are more variable.

These findings align with the broader literature on school-based health promotion. The Cochrane review of the Health Promoting Schools framework found mixed evidence for effectiveness, with some studies demonstrating positive effects on health behaviors and others showing no significant differences.[2] Similarly, a systematic review of school-based nutrition education interventions found that interventions were generally effective at improving nutrition knowledge but had limited effects on dietary intake.[43]

The finding that longer interventions (> 12 months) demonstrated more consistent effects is consistent with the behavior change literature, which suggests that sustained behavior change requires repeated exposure, reinforcement, and practice over extended periods.[44] Brief interventions (≤ 6 weeks), such as Gatto et al,[24] while capable of producing short-term knowledge gains, may be insufficient to overcome entrenched behavioral patterns and environmental barriers. The Canavera et al.[22] pilot study, with its 12-week duration, produced selective improvements in water consumption and outcome expectations but failed to achieve broader behavioral changes, further supporting the importance of adequate intervention duration.

Descriptive Subgroup Synthesis

The descriptive subgroup synthesis reveals several noteworthy patterns. Hygiene and handwashing interventions demonstrated the most consistent success across all outcomes, suggesting SCT may be particularly well-suited for behaviors with immediate, observable consequences and clear environmental cues. In contrast, nutrition-only interventions consistently improved knowledge but failed to achieve sustained behavioral change, highlighting the persistent "knowledge-behavior gap." Combined nutrition and physical activity interventions demonstrated more consistent anthropometric improvements than single-domain approaches, supporting the value of comprehensive, multi-behavior interventions. A dose-response relationship was observed, with extended interventions (> 12 months) showing the most consistent effects, reinforcing that sustainable behavior change requires extended exposure and practice. Additionally, complete theoretical fidelity was associated with more favorable outcomes than partial or no fidelity. However, these descriptive patterns must be interpreted with caution given the small number of studies within each subgroup (n = 2-5) and heterogeneity in outcome measures; they should be considered hypothesis-generating rather than confirmatory.

Implications for Theory and Practice

The findings of this review have several important implications for the application of SCT in school-based health education. First, they highlight the importance of addressing multiple SCT constructs simultaneously. Interventions that targeted a broader range of constructs—including self-efficacy, observational learning, goal setting,

and environmental influences—tended to demonstrate more favorable outcomes than those focusing on a single construct.[19, 27] This supports Bandura's assertion[6] that behavior is determined by the reciprocal interaction of multiple factors and that effective interventions must address personal, behavioral, and environmental determinants.

Second, the findings underscore the importance of considering the developmental appropriateness of SCT constructs. Children and adolescents are in different developmental stages in terms of cognitive capacity, self-regulation skills, and social influences.[45, 46] Interventions that incorporated age-appropriate strategies for goal setting, self-monitoring, and skills building were more effective, suggesting that SCT constructs must be operationalized in developmentally appropriate ways. The success of Canavera et al. [22] with fifth-grade students and Fakehi-Khorasani and Peyman[23] with third-grade students suggests that SCT can be effectively adapted for elementary school children when interventions are age-appropriate and engaging.

Third, the mixed findings for outcome expectations[17, 22, 29] suggest that this construct may require more intensive intervention strategies or may be less salient for certain health behaviors. Outcome expectations are beliefs about the consequences of performing a behavior and are typically targeted through education about benefits and risks.[8] However, knowledge of benefits may not be sufficient to shift outcome expectations, particularly for behaviors where the consequences are distal or uncertain (such as obesity prevention or cancer prevention). Canavera et al.[22] found that outcome expectations improved for behaviors with more immediate consequences (water consumption, television viewing) but not for those with more distal consequences (physical activity, fruit/vegetable intake), suggesting that the temporal proximity of outcomes may influence the effectiveness of outcome expectation interventions.

Fourth, the consistent effectiveness of SCT-based handwashing interventions[23, 25] suggests that SCT may be particularly well-suited for behaviors where the health consequences are immediate and observable, environmental cues are clear and consistent, social norms are supportive, and behavioral skills are relatively simple to acquire. This has implications for the selection of target behaviors in school-based health education and suggests that SCT may be more effective for certain health domains than others.

The findings have several practical implications for school-based health education: 1) The studies that demonstrated the strongest effects were those that maintained high fidelity to the SCT framework.[21, 25, 27] Fidelity checks confirmed that key SCT components—including goal setting, peer collaboration, and active learning strategies—were delivered as prescribed. This underscores the importance of teacher training, ongoing supervision, and fidelity monitoring in school-based health promotion. The Canavera et al.[22] pilot study acknowledged that the intervention was delivered by a physical education teacher without special training, which may have contributed to the limited findings and underscores the importance of adequate teacher preparation. 2) Longer interventions (> 12 months) demonstrated more consistent behavioral and anthropometric outcomes. School-based health education should be conceptualized as a sustained, multi-year effort rather than a brief, one-off program. This requires institutional commitment, curriculum integration, and sustainable funding models. While brief interventions can produce knowledge gains,[23, 24] sustained behavioral change requires extended intervention periods. 3) Interventions incorporating parental involvement and environmental modifications demonstrated more sustained effects. Schools should actively engage parents and families in health promotion efforts and consider environmental changes that support healthy behaviors, such as improved school meal offerings, physical activity facilities, and access to clean water and handwashing stations. 4) Peer-led education demonstrated superior knowledge gains and should be considered a promising delivery format, particularly for sensitive health topics. Peer educators should receive adequate training and ongoing support to ensure fidelity and effectiveness. The success of modeling and social support in Fakehi-Khorasani and Peyman[23] further supports the value of peer-based approaches. 5) Interventions incorporating hands-on activities, role-playing, and skills practice demonstrated more consistent effects on SCT constructs.[21, 22, 24] Didactic, lecture-based approaches are insufficient for building self-efficacy and behavioral skills. The gardening and taste-testing components of the Gatto et al.[24] and Bere et al.[17] studies provided valuable experiential learning opportunities, even when behavioral outcomes were not achieved. 6) The consistent success of handwashing interventions[23, 25] suggests that schools should prioritize hygiene behaviors as a focus for SCT-based interventions, as they may be more amenable to change than complex dietary or physical activity behaviors. The immediate health benefits and clear environmental cues associated with handwashing may enhance intervention effectiveness. 7) The Canavera et al.[22] pilot study demonstrates the value of pilot testing SCT-based interventions before full-scale implementation. Pilot studies can identify implementation challenges, refine intervention components, and provide preliminary evidence of effectiveness. The authors' use of focus groups with students and parents to inform intervention development is a model of community-engaged research that should be replicated.

Methodological Considerations and Limitations

Study quality varied considerably across included studies. While the addition of Canavera et al.[22] and Fakehi-Khorasani and Peyman[23] has expanded the evidence base, both studies had methodological limitations that reduce the strength of their conclusions. Common methodological limitations across the review included: 1) Lack of Long-Term Follow-Up: Most studies assessed outcomes immediately post-intervention or at short-term follow-up

(≤ 12 months). Few studies evaluated the sustainability of behavioral changes beyond the intervention period. This is a significant limitation, as the ultimate goal of health education is sustained behavior change that reduces long-term disease risk.[19, 27] Canavera et al.[22] did not include follow-up assessment, limiting conclusions about the durability of the observed improvements in water consumption and outcome expectations. 2) Measurement Quality: Reliance on self-reported behavioral outcomes was common, introducing potential social desirability and recall bias. While studies of knowledge typically used validated knowledge tests, dietary intake, physical activity, and handwashing were often assessed through self-report rather than objective measures such as accelerometry, direct observation, or biomarker assessment. Future research should incorporate objective measures where feasible. Canavera et al.[22] relied on self-report measures (the Promoting Healthy Lifestyles Survey), and Fakehi-Khorasani and Peyman[23] used self-report questionnaires, both of which may be subject to bias. 3) Sample Size and Power: Some studies had relatively small sample sizes, limiting statistical power to detect meaningful differences. The Canavera et al.[22] pilot study (N = 122) and Fakehi-Khorasani and Peyman[23] study (N = 68) both had relatively small samples, which may have limited the ability to detect statistically significant effects for some outcomes. Large, adequately powered trials are needed to establish conclusive evidence of effectiveness. 4) Study Design Limitations: The Canavera et al. [22] study employed a pre-/post-test design without a control group, which significantly limits causal inferences. Fakehi-Khorasani and Peyman[23] used a quasi-experimental design with a control group, which is stronger but still subject to selection bias. The absence of randomization in these studies reduces confidence that observed effects are attributable to the intervention rather than to other factors. 5) Mediation Analyses: Few studies conducted mediation analyses to determine which SCT constructs were responsible for behavioral change. Without such analyses, it is difficult to determine whether observed effects were indeed attributable to SCT mechanisms or other intervention components. Canavera et al.[22] measured SCT constructs but did not conduct mediation analyses to test the theoretical pathways. Future research should incorporate mediational models to test the theoretical pathways proposed by SCT. 6) Heterogeneity: The heterogeneity of intervention designs, outcome measures, and target populations precluded meta-analysis for many outcomes. This heterogeneity reflects the diverse applications of SCT across different health topics, settings, and populations, but also limits the ability to draw definitive conclusions about effectiveness.

A notable gap in the included studies—and consequently in this review—is the limited attention to ethical considerations in SCT-based school health interventions. School-based research with children raises distinctive ethical issues that were insufficiently addressed across the included studies. While most studies stated that parental consent and child assent were obtained,[21] few provided detailed descriptions of age-appropriate assent procedures, how comprehension was assessed, or how children were informed of their right to withdraw without penalty. Privacy and confidentiality in classroom settings present particular challenges, as interventions may inadvertently expose children's health behaviors or risk status to peers and teachers, potentially leading to embarrassment or teasing.[22] Mental health interventions addressing bullying[29] or non-suicidal self-injury[32] are especially sensitive, yet few studies reported protocols for managing disclosures of harm. Stigmatization and labeling also warrant attention: interventions that recruit overweight/obese children[21, 31] or target "at-risk" populations may inadvertently reinforce negative labels, even when delivered with positive intent. Few studies addressed these risks or reported strategies to mitigate them.

To address these gaps, we recommend that future SCT-based school health interventions provide transparent reporting of assent and consent procedures, develop clear protocols for maintaining confidentiality and managing sensitive disclosures, and proactively address stigmatization through careful recruitment strategies, strengths-based framing, and universal approaches where appropriate. Engaging stakeholders—including children, parents, teachers, and community members—in intervention design and cultural adaptation can enhance both acceptability and ethical soundness. Additionally, future research should systematically report any unintended negative consequences, even if not statistically significant, to ensure that interventions promote health while protecting children's rights and well-being. This ethical dimension should be considered an integral component of intervention design, evaluation, and reporting in school-based health research.

Limitations of This Review

Several limitations of this review should be acknowledged: 1) The review may be subject to publication bias, as studies with null or negative findings are less likely to be published. The inclusion of pilot studies such as Canavera et al.[22] may partially mitigate this, as pilot studies often report mixed findings, but publication bias cannot be ruled out. 2) The review included studies published in English only. While this decision was a practical necessity given the reviewers' linguistic capabilities and the resources available for translation, it likely introduces language bias, with important implications for the review's findings and conclusions. There may be relevant studies published in other languages, particularly from non-English speaking countries where SCT-based health education is also implemented. Additionally, the predominance of studies from Iran (5 of 14 studies) and the USA (5 of 14 studies) may limit generalizability to other cultural and educational contexts, including countries in Africa, South America, Eastern Europe, and parts of Asia. 3) The quality assessment was conducted using standardized criteria, but judgments about quality may involve subjective elements. The absence of blinding in quality assessment may have introduced

bias. 4) The diversity of outcome measures across studies made it difficult to draw definitive conclusions about the effectiveness of SCT-based interventions. Meta-analysis was not feasible for many outcomes due to heterogeneity. 5) Several interventions combined SCT with other theoretical frameworks (e.g., Health Belief Model, socio-ecological theory), making it difficult to isolate the specific contribution of SCT constructs to observed outcomes. This was particularly evident in the Hollis et al.[19] and McKenzie et al.[28] studies. 6) The review included studies published from 2000 to 2025. While this captures the majority of SCT-based school health interventions, studies published before 2000 may have provided additional foundational evidence.

Implications for Future Research

The findings of this review suggest several priorities for future research: 1) Future studies should conduct rigorous mediation analyses to identify which SCT constructs are responsible for behavioral change. Understanding the mechanisms of action is essential for refining interventions and maximizing effectiveness. Moderation analyses should also examine whether intervention effects vary by participant characteristics, such as age, sex, socioeconomic status, and baseline risk status. 2) Studies should include extended follow-up periods (≥ 2 years) to assess the sustainability of behavioral changes. This is essential for determining whether interventions produce lasting health benefits. None of the included studies with the exception of Lytle et al.[27] and McKenzie et al.[28] assessed outcomes beyond 24 months. 3) Where feasible, studies should incorporate objective outcome measures, such as accelerometry for physical activity, biomarkers for dietary intake, clinical measures for anthropometric outcomes, and direct observation or soap/water usage tracking for handwashing. Self-reported outcomes should be supplemented with objective measures to minimize bias. 4) Research is needed on the factors that facilitate or hinder implementation fidelity in school settings. Understanding these factors is essential for translating effective interventions from controlled research settings to real-world practice. The limited findings of Canavera et al.[22] may partly reflect inadequate teacher training, highlighting the need for implementation science research. 5) Few studies have examined the cost-effectiveness of SCT-based school health interventions. Such analyses are essential for informing resource allocation decisions and demonstrating the value of school-based health promotion. Hollis et al.[19] provided a notable exception, demonstrating cost-effectiveness for the Fit-4-Fun program. More such analyses are needed. 6) Future interventions should explore the potential for tailoring SCT-based interventions to individual characteristics, such as readiness to change, self-efficacy levels, and cultural background. Personalized interventions may be more effective than universal approaches. The focus group methodology used by Canavera et al.[22] to inform intervention development is a promising approach to tailoring. 7) With the increasing integration of technology in schools, future research should explore the potential for digital interventions to deliver SCT-based health education in innovative and engaging ways. Mobile applications, interactive websites, and digital games offer new opportunities for skills practice, self-monitoring, and social support. 8) Future research should compare the effectiveness of SCT-based interventions with interventions based on other theoretical frameworks to determine whether SCT offers unique advantages for specific health behaviors or populations. The superior effectiveness of peer-led approaches[30] suggests that delivery format may be as important as theoretical content. 9) Given the promising findings from Fakehi-Khorasani and Peyman[23] and Omura et al,[25] future research should further explore the application of SCT to hygiene behaviors in school settings, including handwashing, oral hygiene, and sanitation practices. The consistent success of these interventions warrants further investigation. 10) The pilot findings of Canavera et al.[22] and the promising results of Fakehi-Khorasani and Peyman[23] should be replicated with more rigorous designs, including larger sample sizes, randomization, and longer follow-up periods, to confirm the effectiveness of SCT-based interventions in these domains.

This review has several strengths. First, it provides a comprehensive and up-to-date synthesis of evidence on SCT-based health education in school settings, incorporating studies published up to 2025. Second, it systematically applies a theoretical lens, examining how specific SCT constructs are operationalized and which constructs are most consistently associated with positive outcomes. Third, the inclusion of diverse health topics (nutrition, physical activity, hygiene, bullying, mental health) demonstrates the broad applicability of SCT across different health domains. Fourth, the detailed data extraction and summary tables provide a clear overview of intervention characteristics, outcomes, and quality, facilitating comparison across studies. Fifth, the inclusion of pilot studies such as Canavera et al.[22] and Fakehi-Khorasani and Peyman[23] provides valuable insights into the challenges and opportunities of SCT-based interventions in real-world school settings, complementing the findings from larger randomized controlled trials. Sixth, the review identifies important gaps in the literature—including the lack of mediation analyses, limited long-term follow-up, and reliance on self-report measures—that can guide future research priorities.

Conclusion

This systematic review examined the application and effectiveness of Social Cognitive Theory-based primary health education interventions in school settings across 14 studies published between 2000 and 2025. The findings demonstrate that SCT provides a robust theoretical foundation for designing school-based health interventions, with consistent positive effects on knowledge acquisition and improvements in key SCT constructs, particularly self-efficacy, behavioral capability,

and social support. However, the evidence for sustained behavioral change and anthropometric improvements is more mixed, with longer, multicomponent interventions incorporating environmental modifications and parental engagement demonstrating more consistent effects. Our findings have demonstrated the potential of SCT-based interventions for obesity prevention and handwashing promotion in elementary school settings. The successful outcomes of handwashing interventions[23, 25] suggest that SCT may be particularly effective for hygiene behaviors where the behavioral pathway from intervention to health outcome is clear, immediate, and reinforced by social and environmental cues.

The findings underscore the importance of addressing multiple SCT constructs simultaneously, incorporating interactive and experiential learning strategies, engaging parents and the broader school environment, and ensuring adequate intervention duration and fidelity. The knowledge-behavior gap observed across studies suggests that knowledge gains, while important, are insufficient for achieving sustained behavioral change without complementary strategies for building self-efficacy, self-regulation skills, and environmental supports.

Future research should prioritize rigorous mediation and moderation analyses, extended follow-up periods, objective outcome measures, and cost-effectiveness analyses. With continued refinement and rigorous evaluation, SCT-based school health interventions have substantial potential to promote lifelong health behaviors and reduce the burden of chronic disease.

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Competing Interests

The authors declare no conflict of interest.

Ethical Approval

This study is a literature review and did not involve human or animal research. It was conducted in full compliance with ethical standards, adhering to principles of academic integrity and transparency.

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Supplementary Files

Supplementary Data File including the search strategy.

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