Title: Systematic review of self-determination theory based interventions for dietary behaviour change in adolescents

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BACKGROUND

In the past decades, rates of childhood obesity and overweight increased substantially across the world, over the last three decades (1). Alongside this, there has been a concerning decrease of quality of diet in the Western countries (2), with excessive intakes of foods rich in fat, sugar and salt (3). In 2015, 35% of adolescents in the United Kingdom classified as overweight or obese, and fell short of government guidelines for healthy dietary intake and physical activity levels (4).

Adolescence is a period of rapid growth, marked by developmental, biological and psychosocial changes, and is therefore a critical point for establishing a trajectory for later health and disease (5). Evidence suggests that a poor diet, reduced physical activity and excessive sedentary behaviour in adolescence increases the risk of developing noncommunicable disease, such as heart disease, stroke, cancer and diabetes in adulthood (5-7). Moreover, investing in health during adolescence can have multiple benefits, as the impact of interventions can affect adolescent's health in the present, their health in the future and the health of the future generation by providing a healthier start for their children (8).

The understanding that adolescence is a period that shapes health in later life and the growing concern regarding poor health habits and food intake in this age group, have led to numerous interventions to promote heathier food choices (9). However, such interventions often only demonstrate small to medium effect sizes and struggle to maintain effects in the long term. This may be partially explained by the lack of understanding of factors associated with adolescents' food choices (10).

During this developmental stage, adolescents tend to demarcate themselves from parental choices and influences, as peers slowly increase their relevance and influence in adolescents' lives. This period is also increasingly marked by adolescents' need for autonomy, including their own personal food choices (11). This need can be a barrier to psychoeducational interventions for dietary changes, since their core foundation is to be prescriptive and didactic and tell adolescents how they should make their choices, which undermines the need of autonomy in this age group and might miss the underlying reasons why this age group might present said behaviours (11, 12). Moreover, conventional interventions often rely on educational and cognitive components, with the intent to increase knowledge of risks of unhealthy eating and promote skills to pursue healthier goals (12, 13). However, the underlying assumption of such approaches is that adolescents have the goal of being healthy in the future and will be motivated by that goal (11), however, this assumption may not be aligned with adolescents' actual behavioural motives (12).

When designing interventions, using conceptual models and theories of behaviour as guides can be useful to help understand and explain the dynamics of health behaviours and the processes involved in behaviour change, as well as potential external factors that contribute to the behaviours. Moreover, the creation of a taxonomy of behaviour change techniques (BCTs) (14) provides a standardised description of potential strategies that can be an invaluable tool for researches to

communicate the specific content of interventions. This enables researchers and health professionals to identify which techniques are promising in promoting behaviour change (15). However, traditional interventions to promote health behaviour change in adolescents tend to rely on decision making theories to promote change (16, 17), while often overlooking motivation for change. Therefore, drawing on motivational theories might advance the design of interventions and improve their effectiveness. One motivation focused theory of behaviour that has been utilised and tested in multiple contexts of behaviour change is self-determination theory (SDT) (18).

The SDT is a humanistic theory of motivation, that emphasizes that behaviours are dependent of a psychological energy – motivation – that directs the person towards a goal (19). This directive energy for action varies within a continuo of a more autonomous or self-driven behaviour to a more externally controlled drive for action (19). More autonomous form of motivation denotes doing something out of enjoyment or because the individual values the benefits of an activity, whilst more controlled form of motivation denote doing something due to external contingencies, such as rewards or punishments (20). The development of optimal motivation is, according to SDT, dependent on three basic psychological needs: autonomy (feeling of empowerment and of having a choice), competence (being effective and capable) and relatedness (connectedness with others as well as being valued by others) (19, 21). According to SDT, where the desired health behaviour does not fulfil these basic psychological needs, it is likely to be more externally motivated and any changes therefore short lived.

A number of randomized controlled trials have looked into the efficacy of SDT-based interventions (22). The results seem promising, with this approach showing particular effectiveness for interventions concerning tobacco dependence (23) and physical activity (24, 25). Far less is known about the effectiveness about such interventions for diet, and even less for dietary interventions in the adolescent population. In order to design more engaging and effective interventions for this age group, it is important to map the existing evidence and identify which strategies of delivering SDT based intervention are most effective. While the evidence around the efficacy of SDT-based interventions is promising, there are still challenges related to translating the theory into practice and knowing which techniques and strategies are most effective and contribute to promoting more autonomous forms of motivation for dietary behaviour change (26).

While there are a few recent systematic reviews on SDT based interventions (22, 26), the focus has been either health behaviour changes in general, or physical activity. To our knowledge no systematic review has explored the application of SDT-based interventions to food choices or dietary changes. Moreover, due to the growing evidence for the need to invest in supporting health in adolescences and the challenges that this developmental stage brings to the design of the interventions, it seems pertinent to explore which interventions strategies (BCTs) have shown to successfully promote autonomous motivation for behaviour change in this population.

AIM AND OBJECTIVES

The aim of the present systematic review is to examine the use of self-determination theory based interventions to promote healthier food choices in adolescents. The review objectives were to explore:

1. What interventions have used a self-determination theory (SDT) approach to support dietary change in adolescents?

2. What behaviour change techniques (BCTs) were used within the interventions, and if possible, which were more effective in promoting autonomous motivation for improving food choices in adolescents?

METHODS

Criteria for study inclusion

Key eligibility criteria for this review are associated with study, population, intervention and outcomes (Table 1).

Types of study

Interventional studies using an experimental or quasi-experimental design, with or without control group. Observational studies will be excluded, as the focus of the systematic review is to explore the existent interventions available to change dietary patterns.

Types of participants

Studies including non-clinical sample of adolescents, between 10-19 years. Studies that include both children and adolescents, will be excluded unless adolescent data has been presented separately to data from children. Studies will be excluded if the interventions included participants with any form of neurodevelopmental disorders, which includes intellectual disabilities, autism spectrum disorder, attention-deficit/hyperactivity disorder (ADHD) or learning disorder (such as dyslexia). Studies that include populations with depressive or anxiety disorders will be also excluded.

Types of intervention

Self-determination theory will be used to define which studies to include. Interventions that used this framework to design interventions for dietary change will be included. Studies will also be included if they include any dimension of SDT theory within the intervention design, even if the theoretical framework itself is not named. Such features include mentions of autonomous motivation and/or the basic psychological needs (autonomy, competence, relatedness) (Ryan & Deci, 2000). Studies will be excluded if they do not include self-determination theory elements in the design of the intervention.

Outcome of interest

Intervention studies will be included if they explore motivation (e.g. need satisfaction, behavioural regulation) for change or dietary change in adolescents. Additionally, studies that measure behavioural outcomes, in specific, dietary behaviour, will also be included. Dietary behaviour, as an umbrella term, include food choice (e.g., preferences, food preparation or intention to eat), eating behaviour (e.g. habits, portions, frequency), and nutrition or dietary intake (e.g. fruit and vegetable intake, servings per day, meal pattern and dietary pattern) (27). Moreover, studies reporting behaviour related outcomes, such as body composition (e.g. BMI, weight), will also be included. Studies will be included if they measured the outcome at baseline and at least one more time point. If studies measure other outcomes, they will be included if the outcome of interest is clearly, individually and separately reported, such as weight or BMI.

Table 1- Inclusion and exclusion criteria

	Inclusion	Exclusion
Study design	Interventional studies with or without control group. Experimental and quasi-experimental studies.	Observational studies.
Population	Non-clinical adolescents, age between 10-19 years.	Children below age of 10 years. Adult population. Participants with neurodevelopmental disorders or psychological disorders.
Intervention	Interventions explicitly using the SDT framework to target dietary change. Interventions designed with constructs of the SDT.	Interventions using any other theory or framework.
Outcome	Measurements of motivation outcomes, behavioural outcomes or behaviour related outcomes. Baseline and follow-up measures of the outcomes.	

Search strategy and Study Selection

The aim of the search will be to identify all the relevant published papers available on the following databases: MEDLINE, CINAHL, Embase, PsycINFO, ERIC, Cochrane library and Scielo. Each step of the search will be documented to ensure transparency and enable future replication.

In addition to the database search, bibliographic searches of the included studies will be performed. Moreover, the database resource tools, as well as Google scholar tools, such as find similar or find citing articles, will be used to assure that all relevant articles have been included in the review. Visual inspection of the reference list of the included studies and search the SDT website will be conducted to ensure all the papers are included.

Search terms

The initial search terms will be developed in consultation with experts in the field of behaviour change and in literature search. A combination of medical subject headings (MeSH) and free-text terms will be used to identify self-determination theory based interventions that target adolescents and are aimed to improve or change dietary behaviours. See Appendix for a complete search strategy.

Search Flow and management

An initial screening of all titles and abstracts will be performed and the titles and abstracts will be assessed against the inclusion and exclusion criteria by two independent reviewers. The next step will be to obtain full copies of articles identified by the search that are considered to meet the inclusion criteria. Studies will then be reviewed by two independent researchers that will mark them, using Rayyan website, as either excluded, included or marked as “pending” in case the reviewer is unsure about their exclusion. Data extraction from the included studies will be conducted by two reviewers to ensure rigor. Any disagreement during the screening process will be discussed between reviewers and when a consensus cannot be researched a third reviewer will be

consulted to reach a decision. Inter-rater agreement will be calculated and reported in the final write up of the study.

Endnote and Rayyan will be used to manage references, remove duplicated references and keep track of the two screening stages. Rayyan will be use to ensure a blind coding during the screening process.

Data extraction

The data extraction will be done using a structured guide to reduce any potential reviewer bias and ensure that the process is as reliable as possible (28). For each included article, the following information will be extracted: general study details (e.g. authors, year of publication, study design, sample size), information about participants, intervention (frequency, duration, intensity of intervention, method of delivery, integrity of intervention), BCTs included in the interventions, and assessment of the reported outcomes.

Dealing with duplicate publications

To ensure that the retrieved studies are not duplicated the following methods will be used: 1) Ovid multifile search will be used when searching Embase; 2) Endnote and Rayyan will be used to record and manage references, identify and remove duplicate references and keep track of the literature search process.

Assessment of risk of bias in included studies

Intervention quality for randomized control trials (RCTs) will be evaluated with the Cochrane risk of bias tool, which evaluates the following domains: random sequence generation, allocation concealment, selective reporting, blinding participants and personnel, blinding of outcomes assessment, incomplete outcome data and other bias. Risk of bias criteria will be classified as low risk, high risk and unclear risk.

In line with the inclusion criteria, an additional quality assessment will be used for interventional studies that are not RCTs. A previous systematic review (29) developed a quality checklist based on the criteria described by the Centre for Reviews and Dissemination (2009). The checklist asses the risk of bias resulting from study design, randomization, blinding, selection, attrition, assessment, intervention fidelity, analysis and how the studies handle confounding (29).

Two researchers will assess the risk of bias of each study independently. Any disagreement will be solved by discussing the study until a consensus is reached or consulting with a third researcher.

Data synthesis

This systematic review will be reported according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines (30). If possible, a meta-analysis will be conducted, using a random effects analysis (31).

If a meta-analysis is not possible, a narrative synthesis will be conducted to collate the findings of the included studies. Summary tables will be produced to present a descriptive summary of the studies, the results and quality assessment.

Following a framework for narrative synthesis developed by Popay and colleagues (32), this systematic review will develop a theoretical framework on how interventions based on SDT might support diet changes in adolescents. After data extraction, a preliminary synthesis of the included

studies will be conducted, exploring how the SDT framework was applied to the design of interventions, which BCTs are included in the interventions and their effects on the main outcome.

Following the initial description, relationships within and between studies will be explored, as well as potential emergent patterns and potential factors that might explain the variations in the outcome.

The final step, following Popay et al (32), will be to explore the robustness or quality of the narrative synthesis. Methodological quality assessment of the included studies will be conducted, and source of bias will be discussed. The influence of these factors on the overall systematic review will be discussed.

DISSEMINATION

The aim of this systematic review is to contribute to the body of knowledge about health interventions and potential behaviour techniques that might effectively increase motivation for a dietary change in adolescent populations. This knowledge may inform the design of future interventions to promote changes in dietary patterns during adolescence. The findings of this review will be disseminated through peer-reviewed publications and delivery of presentations and/or posters at relevant national and international research conferences.

REGISTERING AND REVIEWING THE PROTOCOL

Previous versions of the protocol were reviewed by an academic psychologist and an academic health psychologist with expertise in health behaviour, who gave feedback on search terms and search strategy, contributing to the modifications of the protocol. The systematic review methodology will be registered to PROSPERO.

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