

Integrating the Theories of Bandura, Maslow, Pavlov and Skinner in Constructing Conceptual Framework of Obesity-Related Behaviour Among TVET Adolescents

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ABSTRACT

Overweight and obesity among adolescents have become one of the most pressing public health concerns in Malaysia, where the combined prevalence of overweight and obesity among adults rose from the mid-forty percent range in 2011 to 54.4 percent in 2023, and where roughly 30.5 percent of adolescents were classified as overweight or obese in the 2022 Adolescent Health Survey. Students in Technical and Vocational Education and Training (TVET) institutions, particularly those enrolled in culinary arts, bakery and pastry programmes, represent a distinctive yet under-researched group because they are continuously exposed to energy-dense food during practical training. Most existing frameworks explain obesity-related behaviour through a single theoretical lens, which limits the capacity to capture the interaction between personal, environmental and behavioural determinants. This conceptual paper proposes an integrated framework that synthesises Bandura's Social Cognitive Theory, Maslow's Hierarchy of Needs, Pavlov's Classical Conditioning and Skinner's Operant Conditioning to explain overweight status among TVET adolescents. The four theories were selected against explicit criteria and assigned mutually exclusive explanatory jurisdictions, so that each accounts for a mechanism the others do not: reciprocal person–environment–behaviour interaction, motivational prepotency of basic needs, acquisition of cue-driven eating, and maintenance of behaviour through reinforcement. Drawing on a structured narrative synthesis of literature published between 2021 and 2026, conducted under a stated search and selection protocol, the paper advances eight numbered propositions linking gender, socioeconomic status, programme of study, dietary habits and physical activity to overweight status through self-esteem, and states for each proposition the supporting evidence and the strength of its current warrant. Self-esteem is specified as one candidate mediator rather than the only one, and competing specifications involving self-efficacy and broader psychological well-being are set out for competitive testing. Determinants that fall outside the behavioural model, including genetic predisposition, sleep duration, family food environment, food security and cultural dietary practice, are identified and assigned an explicit treatment as covariates or acknowledged limitations. The paper further specifies measurable indicators and instruments for every construct and a five-phase validation plan progressing from instrument piloting in Sabah, through structural equation modelling and a culinary versus non-culinary programme comparison, to multi-region replication with measurement invariance testing and longitudinal and intervention studies. The framework contributes a testable multi-theoretical structure to behavioural nutrition research and addresses a clear contextual gap concerning culinary TVET learners in Sabah, Malaysia. Implications for nutrition education, institutional policy and adolescent health promotion are discussed.

Keywords: obesity, conceptual framework, learning theories, TVET adolescents, self-esteem

INTRODUCTION

Overweight and obesity have evolved into a complex, multidimensional global public health challenge since the late twentieth century. The World Health Organization (2024) has repeatedly documented a sharp increase in the prevalence of overweight and obesity across most regions, including the countries of Southeast Asia. Obesity

is no longer regarded merely as an aesthetic concern; it is a chronic condition that contributes to non-communicable diseases such as type 2 diabetes mellitus, hypertension and cardiovascular disease, and it imposes a substantial and growing burden on national health systems (Subramaniyan, 2026). Understanding why obesity develops, and why it persists into adulthood, therefore requires more than the measurement of prevalence. It requires a theoretical account of the behaviours, environments and psychological states that produce and maintain excess weight.

Obesity was formally recognised as a global epidemic by the World Health Organization in 1997, and the condition is conventionally defined through the body mass index (BMI), calculated as weight in kilograms divided by the square of height in metres, with values of 25.0 to 29.9 classified as overweight and values of 30.0 or above classified as obese under the standard thresholds (World Health Organization, 2022). For Asian populations, lower cut-off points are often applied because cardiometabolic risk emerges at a lower BMI, and Malaysian clinical guidance reflects this consideration. Although BMI has known limitations, notably its inability to distinguish lean mass from fat mass, it remains a practical, low-cost and internationally accepted screening tool for population studies, and it is frequently supplemented by anthropometric measures such as the waist-to-hip ratio to capture abdominal adiposity (Freihat et al., 2025).

In Malaysia the trend is well documented. Successive rounds of the National Health and Morbidity Survey show that the combined prevalence of overweight and obesity among adults rose from the mid-forty percent range in 2011 to approximately 54.4 percent in 2023, with abdominal obesity continuing to increase in parallel (Subramaniyan, 2026). Among adolescents the picture is equally concerning. The Adolescent Health Survey component of the National Health and Morbidity Survey 2022 reported that roughly 30.5 percent of Malaysian adolescents were either overweight or obese, with females more prevalent in the overweight category (Institute for Public Health, 2022, as cited in Yong et al., 2024). A systematic review and meta-analysis of childhood and adolescent obesity in Malaysia confirmed that national surveys have tracked a consistent upward trajectory over more than two decades (Chua et al., 2025). The COVID-19 pandemic appears to have accelerated this trend: the incidence of obesity among Malaysian adolescents aged thirteen to seventeen years rose from 10.6 percent in 2012 to 14.3 percent in 2022, a period encompassing disrupted routines, increased sedentary behaviour and a shift toward convenience foods (Lee, 2025). These figures matter because dietary and lifestyle patterns formed during adolescence tend to persist into adulthood, which makes early, theory-informed intervention critical.

Adolescence is a transitional stage marked by rapid physical, emotional and social development, during which young people form self-identity, including perceptions of body image and health. Within this stage, students in Technical and Vocational Education and Training (TVET) institutions occupy a particularly distinctive position. The Malaysian TVET system has been the subject of significant investment under successive Malaysia Plans, and vocational colleges now enrol large numbers of adolescents in applied programmes that include culinary arts, bakery and pastry, engineering and hospitality (Amin et al., 2023). Vocational learning demands active participation in practical sessions and, for programmes such as culinary arts and bakery and pastry, continuous exposure to food. This environment has the potential to influence dietary patterns, meal frequency and daily energy intake in ways that differ from the experience of students in mainstream academic schooling. Recent Malaysian scholarship has begun to examine the health and quality of life of TVET populations, yet the evidence base remains thin and fragmented, and rarely addresses the culinary sub-population directly (Yasin et al., 2024).

A further complication is that most studies of adolescent obesity draw on a single theoretical perspective. Behavioural nutrition research has relied heavily on Social Cognitive Theory to design interventions, and systematic reviews confirm its dominance in school-based nutrition and physical activity programmes (Bagherniya et al., 2018). Motivational accounts frequently invoke Maslow's hierarchy of needs, learning-based accounts of appetite draw on Pavlovian conditioning through the construct of food cue reactivity (Boswell & Kober, 2022), and behaviour-change accounts rely on Skinnerian reinforcement. Each perspective illuminates part of the phenomenon, but no single theory captures the reciprocal interplay among personal factors, environmental exposure and learned behaviour that appears to drive overweight status in a food-saturated vocational setting. This fragmentation constitutes the central problem addressed in the present paper.

A second qualification must be entered at the outset. Obesity is a multifactorial condition, and no behavioural model can claim to account for all of its variance. Genome-wide association studies indicate that common genetic variation explains more than twenty percent of variation in body mass index (Locke et al., 2015); short sleep duration approximately doubles the odds of overweight in longitudinal paediatric studies (Fatima et al., 2015); parental feeding practices and the family food environment are among the strongest determinants of children's eating behaviour (Scaglioni et al., 2018); and population-level energy intake is shaped by global food-system drivers acting through local environments (Swinburn et al., 2011). The framework developed here does not dispute any of this. It is deliberately restricted to the modifiable behavioural and psychosocial layer that vocational institutions can actually influence, and it treats the remaining determinants either as measured covariates or as acknowledged sources of unexplained variance. This scope decision is stated explicitly, and its consequences are set out in Table 1 and revisited in the limitations.

The economic dimension of the problem reinforces its urgency. Estimates of the direct and indirect costs of obesity across major economies fall between two and five percent of gross domestic product, driven by the treatment of obesity-related non-communicable diseases and by lost productivity (Okunogbe et al., 2021). For a developing health system, the diversion of scarce resources toward preventable chronic disease is a serious concern, and it strengthens the case for prevention that begins in adolescence. Because prevention depends on an accurate understanding of the behavioural mechanisms that produce excess weight, the theoretical clarity offered by an integrated framework has practical as well as scholarly value.

The objective of this conceptual paper is therefore to construct and justify an integrated framework that synthesises the theories of Bandura, Maslow, Pavlov and Skinner to explain obesity-related behaviour among TVET adolescents, with particular reference to culinary students in Sabah, Malaysia. The paper first reviews the empirical landscape of adolescent obesity and its psychosocial correlates. It then presents each theory and its relevance to the constructs of interest, before integrating them into a single coherent model in which gender, socioeconomic status, programme of study, dietary habits and physical activity influence self-esteem, which in turn influences overweight status. Finally, the paper discusses the theoretical, methodological and practical implications of the framework, and outlines directions for its empirical validation. The contribution is fourfold. The paper offers a testable multi-theoretical structure that responds to repeated calls for integrative models in behavioural nutrition; it assigns each theory an explicit and non-overlapping explanatory jurisdiction, so that integration does not collapse into eclecticism; it states each proposed relationship as a numbered proposition accompanied by its supporting evidence, its competing alternatives and an operational measurement plan; and it addresses a specific contextual gap concerning vocational culinary learners who have been largely absent from the Malaysian obesity literature.

LITERATURE REVIEW

This section reviews four bodies of literature that inform the proposed framework. It begins with the epidemiology of adolescent overweight and obesity in Malaysia and comparable settings, proceeds to the psychosocial correlates of excess weight with particular attention to self-esteem, examines the food environment of vocational and culinary education, and finally considers the theoretical traditions that have been used to explain obesity-related behaviour. The review establishes both the empirical justification and the conceptual gap that the framework seeks to fill.

Epidemiology of Adolescent Overweight and Obesity

The prevalence of adolescent overweight and obesity has risen steadily across Asia, and Malaysia is frequently cited as having one of the highest rates in Southeast Asia. A cross-sectional study of 2,221 secondary school adolescents in Seremban reported an overweight prevalence of 17.0 percent and an obesity prevalence of 14.9 percent, and identified breakfast skipping and low physical activity as significant predictors (Lai et al., 2024). A systematic review and meta-analysis of childhood and adolescent obesity in Malaysia synthesised data across two decades and confirmed a persistent upward trend, while noting considerable heterogeneity across states, ethnic groups and measurement methods (Chua et al., 2025). At the national level, analyses of long-term trends

show that Malaysia moved from a low-to-moderate to a high prevalence category between 1990 and 2023, a transition attributed to urbanisation, dietary change and reduced physical activity (Subramaniyan, 2026).

Two features of this literature are relevant to the present framework. First, the significant predictors identified repeatedly, namely meal patterns, physical activity and psychosocial variables, are behavioural and modifiable rather than fixed, which invites a learning-based and motivational explanation. Second, sex differences are consistently reported, with females more prevalent in the overweight category in the national adolescent survey and in several state-level studies (Lai et al., 2024). These observations support the inclusion of gender, dietary habits and physical activity as explanatory constructs and justify treating overweight status as an outcome of interacting behavioural and demographic factors rather than a purely biological endpoint.

Physical activity is a second modifiable determinant that recurs throughout the epidemiological literature. Global analyses identify physical inactivity as a major contributor to obesity, hypertension and the early onset of chronic disease, and the problem is acute among adolescents who spend increasing amounts of time in sedentary and screen-based activity (Milton et al., 2023). In the Malaysian context, a study of body composition and obesity risk among multi-ethnic adolescents found that physical activity was significantly associated with lean mass, underscoring the protective role of activity even where its association with fat percentage is complex (Zulfarina et al., 2022). Systematic review evidence further links physical activity with body image perception in adolescents, suggesting that activity influences not only physiological outcomes but also the psychological constructs that mediate weight status (Gualdi-Russo et al., 2022). These findings justify the inclusion of physical activity as a behavioural determinant that operates alongside dietary habits and that plausibly influences self-esteem.

Self-Esteem and The Psychosocial Correlates Of Obesity

Self-esteem occupies a central position in the psychosocial literature on adolescent obesity, and the relationship appears to be bidirectional. A longitudinal analysis of the United Kingdom Millennium Cohort Study modelled self-esteem, happiness with appearance, dieting and bullying as mediators of the cross-lagged relationship between mental health and body mass index across adolescence, and found evidence of a cyclical relationship in which poorer psychological states and higher body mass index reinforce one another over time (Bjertnaes et al., 2023). Cross-sectional evidence from Southeast Asia similarly reports significant associations between obesity and low self-esteem among female adolescents (Nisa et al., 2022). Studies of Korean adolescents have linked body mass index, dietary habits, subjective health and body image perception, showing that negative body image and low self-esteem frequently accompany higher body mass index and can obscure young people's understanding of their own health status (Kim et al., 2025).

This body of work justifies positioning self-esteem as a proximal psychological determinant of overweight status rather than as a simple outcome. If self-esteem shapes dietary restraint, physical activity engagement and body image, and is simultaneously shaped by weight-related stigma, then it functions as a mediating construct through which demographic and behavioural factors exert their influence. The proposed framework adopts this mediating role, consistent with the reciprocal logic of Social Cognitive Theory and the motivational logic of Maslow's hierarchy, both of which are elaborated below.

Self-perception adds a further layer of complexity. National trend analyses show that self-perceived overweight frequently diverges from body mass index-based classification, and that self-perception is patterned by academic performance, economic status and stress (Jeong et al., 2024). Eating disorders, which are closely tied to self-esteem, have also been documented among adolescents and are associated with distorted self-evaluation (Nesrine et al., 2025). For culinary students, whose professional identity is bound up with food, the interaction between self-perception, self-esteem and weight status may be especially intricate. The framework accommodates this complexity by treating self-esteem as a psychological hub rather than as an isolated variable, allowing it to absorb the influence of body image, self-perception and social comparison while transmitting that influence onward to weight status.

The Food Environment of Vocational and Culinary Education

Environmental exposure to food is a recognised driver of dietary behaviour and weight status. A systematic review of the university food environment concluded that the availability and accessibility of energy-dense food in educational and workplace settings influences student dietary behaviour, and that repeated exposure can normalise higher-calorie consumption (Roy et al., 2022). Occupational studies extend this logic to food-handling environments, reporting that food-service workers frequently present with overweight and elevated body mass index, consistent with the idea that continuous proximity to food shapes intake (Santos et al., 2022). Paradoxically, the relationship between culinary competence and weight is not straightforward. A cross-sectional study of undergraduates found that lower cooking skills were associated with overweight and obesity, suggesting that culinary knowledge alone does not guarantee healthier outcomes and may interact with self-efficacy and food choice in complex ways (Rodrigues et al., 2023).

For culinary and bakery students, these findings converge on a distinctive risk profile. Such students combine high exposure to palatable, energy-dense food during practical training with the very culinary competence that the general literature associates with healthier eating, yet they operate within an environment that continuously presents food cues. This tension between knowledge and exposure is precisely the kind of phenomenon that a single-theory model struggles to explain, and it motivates the integration of conditioning-based accounts of cue reactivity with cognitive and motivational accounts of behaviour.

Theoretical Traditions in Obesity-Related Behaviour

The Multifactorial Aetiology of Obesity and the Scope of the Present Model

The determinants reviewed above are behavioural and psychosocial, and they are the determinants that a vocational institution can plausibly act upon. They are not, however, the only determinants of adolescent obesity, and a framework that failed to say so would misrepresent the condition it seeks to explain. Obesity has an established genetic architecture, a sleep-related physiology, a family and household context, and a wider food-system environment, each of which contributes variance that no classroom intervention will remove.

The position adopted here is one of declared scope rather than silent omission. The framework models a specific causal layer: the demographic, behavioural and psychological determinants of overweight status among vocational learners exposed to a food-rich training environment. Determinants outside that layer are handled in one of three ways. Some are measured and entered as covariates in the validation study, so that the modelled paths are estimated net of their influence. Some are represented indirectly by constructs already in the model, most obviously the training-kitchen environment captured through programme of study. One, genetic predisposition, is neither measured nor represented, and is treated as an acknowledged ceiling on the proportion of variance the framework can explain. Table 1 sets out this allocation explicitly.

Table 1. Determinants of adolescent obesity outside the modelled layer and their treatment in the framework

Determinant domain	Evidence and relevance	Treatment in the present framework
Genetic predisposition	Genome-wide analysis of 339,224 individuals identified 97 loci associated with body mass index, and common variation is estimated to account for more than twenty percent of variation in body mass index (Locke et al., 2015).	Outside the scope of the model. Acknowledged as unmeasured background variance and reported as a limitation on explained variance.
Sleep duration	Bias-adjusted meta-analysis of longitudinal studies found that short sleepers had approximately twice the odds of	Measured covariate. Hypothesised to act partly through dietary habits and is therefore entered as a control on the P1 and P5 paths.

	overweight or obesity relative to long sleepers (Fatima et al., 2015).	
Family food environment and parental feeding practice	Parental food habits and feeding strategies emerge as the dominant determinants of children's eating behaviour and food preferences (Scaglioni et al., 2018).	Measured covariate. Conceptually adjacent to the observational-learning mechanism supplied by Social Cognitive Theory and reported alongside it.
Household food availability and food security	Seasonal food insecurity among urban poor Malaysian adolescents is associated with poorer diet quality and nutritional status (Tay et al., 2023).	Measured covariate. Operationalises the physiological tier of Maslow's hierarchy and is used to test whether the socioeconomic pathway survives adjustment.
The wider obesogenic environment	Population weight gain is driven by global food-system dynamics expressed through local environments rather than by individual choice alone (Swinburn et al., 2011).	Partly represented through programme of study and training-kitchen exposure. The wider environment is held constant by the single-system sampling frame and acknowledged as a limitation.
Cultural and ethnic dietary practice	National reviews report substantial heterogeneity in adolescent obesity prevalence across ethnic groups and states (Chua et al., 2025; Zulfarina et al., 2022).	Measured covariate. Multi-group analysis by ethnic group is planned where cell sizes permit.
Screen and sedentary time	Physical inactivity is identified as a leading contributor to obesity and early chronic disease among adolescents (Milton et al., 2023).	Measured covariate reported alongside physical activity, so that activity and inactivity are not conflated.
Psychological well-being beyond self-esteem	Disordered eating and distorted self-evaluation are documented among adolescents (Nesrine et al., 2025), and psychological state and body mass index reinforce one another over time (Bjertnaes et al., 2023).	Modelled as a parallel mediator in the competing specification described in the discussion, rather than being absorbed into self-esteem.

Two consequences follow. The first is analytic: because the model is partial by design, its structural coefficients should be interpreted as the contribution of the behavioural layer conditional on the covariates, not as a complete account of overweight status. The second is practical: interventions derived from the framework should be expected to shift behaviour and psychological state, and to shift weight status only modestly and over time, since a substantial share of the variance in body mass index lies beyond their reach.

Four theoretical traditions recur in the literature on obesity-related behaviour. Social Cognitive Theory, with its principle of reciprocal determinism among personal, behavioural and environmental factors (Bandura, 1986), has been the dominant framework for school-based nutrition and physical activity interventions, and systematic reviews confirm its widespread application to adolescent obesity prevention (Bagherniya et al., 2018). Maslow's hierarchy of needs (Maslow, 1970) has been used to explain why the satisfaction of basic physiological and safety needs precedes higher-order concerns such as esteem and self-actualisation, a logic that has clear relevance to socioeconomically constrained adolescents whose food choices are shaped by cost and availability (Stoyanov, 2017). Pavlovian classical conditioning (Pavlov, 1927) underlies the construct of food cue reactivity, defined as behavioural and physiological sensitivity to conditioned food cues, which is elevated in individuals with obesity and predicts eating and weight gain (Boswell & Kober, 2022). Skinnerian operant conditioning (Skinner, 1953)

explains how reinforcement and punishment shape and maintain dietary and physical activity behaviours over time.

Despite the frequency with which these theories appear, they are seldom integrated. Reviews of theory use in Malaysian educational and behavioural research note that studies tend to apply a single framework and rarely articulate how personal, environmental and behavioural mechanisms combine (Kamrozzaman et al., 2020). The same tendency toward single-theory application has been observed in technology-enhanced and lifelong-learning contexts, where integrative modelling has been advocated as a means of capturing the full complexity of learner behaviour (Elias et al., 2025). The present paper responds directly to this gap by proposing a coherent synthesis rather than a sequential listing of theories.

Criteria for theory selection and the avoidance of conceptual overlap

Combining four theories risks two failures. The first is redundancy, in which two theories explain the same relationship in different vocabulary and the framework gains breadth without gaining explanatory power. The second is eclecticism, in which theories are listed rather than integrated and no principle governs which theory accounts for which relationship. To avoid both, the four theories were selected against four stated criteria and then assigned mutually exclusive explanatory jurisdictions.

The criteria were as follows. A theory was retained only if, first, it supplied a mechanism that none of the other retained theories supplied; second, that mechanism could be attached to at least one specific construct or path in the framework rather than to the phenomenon in general; third, the mechanism had contemporary empirical support within the eating and obesity literature and not merely within general psychology; and fourth, the mechanism was consequential for intervention design, in the sense that acting on it would imply a different intervention from acting on the others. Applying these criteria produced a division of labour in which Social Cognitive Theory supplies the architecture of the model, the Hierarchy of Needs supplies motivational prepotency, Classical Conditioning supplies the acquisition of appetitive responses, and Operant Conditioning supplies the maintenance of behaviour through consequences. The allocation is set out formally in Table 3, which states for each theory both what it explains and what it does not, so that the boundary between adjacent theories is visible and falsifiable.

The same criteria account for the theories that were considered and not retained. The Theory of Planned Behaviour and the Health Belief Model were excluded because their deliberative, intention-forming component substantially duplicates the self-efficacy and outcome-expectancy mechanisms already supplied by Social Cognitive Theory, and their addition would have violated the non-redundancy criterion. Socio-ecological models were excluded on different grounds: they specify levels of influence rather than psychological mechanisms, and so cannot be assigned a jurisdiction over a path. Their contribution is nevertheless retained, in the covariate layer described in Table 1, where household, family and wider environmental determinants are represented explicitly.

METHODOLOGY

Research Design

This paper adopts a conceptual research design. Its purpose is not to report new empirical data but to construct, justify and articulate an integrated theoretical framework that can subsequently be tested. Conceptual papers are an established genre in social science, and they contribute by organising fragmented literature, clarifying constructs and proposing relationships that guide future empirical work (Jaakkola 2020). A conceptual design is appropriate here because the central problem, namely the fragmentation of theoretical accounts of adolescent obesity, is itself theoretical, and because the framework developed is intended to serve as the conceptual foundation for a broader mixed-method study of overweight status among vocational college students in the Sabah zone of Malaysia.

Search Strategy and Source Selection

The reviewer of an integrative conceptual paper is entitled to know how its evidence base was assembled, because a synthesis whose selection procedure is undocumented cannot be distinguished from a synthesis assembled to fit a preferred conclusion. A structured narrative synthesis was therefore conducted according to scoping-review principles, with the protocol stated in advance and reported in Table 2. The procedure does not amount to a systematic review, and the respects in which it falls short are stated in the final row of the table rather than left to inference.

Table 2. Search and Source-Selection Protocol

Protocol element	Specification
Databases searched	PubMed, Scopus and Web of Science as primary sources, supplemented by Google Scholar for forward and backward citation chaining and by Malaysian government publications for national prevalence data.
Search strings	Substantive strings combined ("adolescent" OR "youth" OR "vocational" OR "TVET") AND ("obesity" OR "overweight" OR "body mass index") AND ("self-esteem" OR "dietary habits" OR "physical activity" OR "food environment"). Theoretical strings combined ("social cognitive theory" OR "hierarchy of needs" OR "classical conditioning" OR "food cue reactivity" OR "operant conditioning" OR "reinforcement") AND ("eating" OR "obesity" OR "weight").
Date limits	Empirical and review sources restricted to 2021–2026 to reflect the current evidence base. Foundational theoretical works and standard measurement references were retained irrespective of date, since they define the constructs rather than evidence them.
Language	English-language publications, with Malaysian national survey reports accepted in either English or Malay.
Inclusion criteria	Peer-reviewed empirical studies, systematic reviews and meta-analyses addressing overweight, obesity or their behavioural and psychosocial correlates in adolescents or young adults; theoretical works defining one of the four mechanisms; national or international reports providing prevalence or classification standards; validated measurement instruments.
Exclusion criteria	Clinical, surgical or pharmacological treatment studies; studies restricted to children under ten years; conference abstracts and preprints without accessible full text; commentary or opinion pieces without empirical or theoretical contribution; sources whose methods could not be inspected.
Screening procedure	Titles and abstracts were screened against the four review themes, namely epidemiology, psychosocial correlates, the educational food environment and theoretical explanation. Retained records were read in full, and their reference lists were searched for further eligible sources until no new relevant material was identified.
Corpus retained	Forty-three sources were retained and are listed in the references. They comprise foundational theoretical works, systematic reviews and meta-analyses, primary empirical studies, national and international survey or classification reports, and measurement sources.

Stated limits of the procedure	Screening and extraction were conducted by a single reviewer without independent duplication, and no formal risk-of-bias appraisal was applied. The procedure is therefore reported as a structured narrative synthesis conducted according to scoping-review principles, and not as a systematic review. This limitation is restated in the limitations section.
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Two features of the protocol deserve comment. The restriction of empirical sources to the period from 2021 to 2026 was adopted because adolescent dietary and activity patterns were materially disrupted by the pandemic, and evidence collected before that disruption may not describe the population the framework addresses. Foundational theoretical works were exempted from the restriction for the obvious reason that they are the objects of the synthesis rather than evidence within it. The exclusion of clinical treatment studies reflects the scope decision set out in Table 1: the framework addresses the behavioural determinants of weight status in an educational setting, not its clinical management.

The synthesis proceeded thematically across four bodies of literature: the epidemiology of adolescent obesity, the psychosocial correlates of excess weight, the food environment of educational settings, and the theoretical explanation of eating and physical activity behaviour. These four themes correspond to the four sections of the review presented above.

Data analysis

The synthesis proceeded in three stages. First, the core mechanism proposed by each theory was extracted from the foundational and contemporary literature. Second, each mechanism was mapped onto the constructs of gender, socioeconomic status, programme of study, dietary habits, physical activity, self-esteem and overweight status. Third, the points at which the theories converge and complement one another were identified and articulated as directional propositions, producing the integrated framework presented in the following section. A fourth stage was added in response to the risk of interpretation bias inherent in narrative work: each proposition was returned to the retained corpus and matched against the specific studies that support it, and the strength of that support was graded as strong, moderate, limited or untested. Propositions for which no direct evidence could be located were retained but marked as untested rather than being supported by analogy. The outcome of this stage is reported in Table 4, which allows a reader to see precisely which parts of the framework rest on evidence and which rest on theoretical inference alone.

RESULTS

The synthesis produced a framework of seven constructs. Three demographic constructs, namely gender, socioeconomic status and programme of study, function as exogenous factors. Two behavioural constructs, dietary habits and physical activity, function as intermediate factors. Self-esteem functions as a proximal psychological mediator, and overweight status, operationalised through body mass index for age in accordance with the World Health Organization growth reference (de Onis et al., 2007), functions as the outcome. A layer of contextual covariates, specified in Table 1, surrounds the model without forming part of its causal claims.

The framework is stated as eight numbered propositions rather than as a general assertion of influence, so that each relationship can be tested, and falsified, independently of the others. Proposition 1 holds that demographic factors are associated with dietary habits and physical activity. Proposition 2 holds that demographic factors are associated with self-esteem. Proposition 3 holds that dietary habits and physical activity are associated with self-esteem. Proposition 4 holds that self-esteem is inversely associated with overweight status. Proposition 5 holds that demographic factors retain a direct association with overweight status that is not transmitted through the behavioural and psychological pathway. Proposition 6 holds that overweight status feeds back onto self-esteem, so that the relationship specified in Proposition 4 is reciprocal rather than unidirectional. Proposition 7 holds that programme of study moderates the relationship between food-cue exposure and dietary habits, such that enrolment in culinary or bakery programmes strengthens it. Proposition 8 holds that self-esteem mediates only partially, and that self-efficacy and broader psychological well-being operate as parallel mediators alongside it.

Table 3 sets out the explanatory jurisdiction assigned to each theory, including what each theory does not explain, and Figure 1 presents the resulting model. Table 4 then states, for each proposition, the evidence that currently supports it and the strength of that support.

Reading the framework as a set of propositions rather than as a diagram has a further advantage. It makes explicit that the model is a hypothesis about a population that has not yet been surveyed, and it identifies in advance the observations that would count against it.

Table 3. Explanatory jurisdiction of each theory within the integrated framework

Theory	Unique mechanism contributed	Segment of the framework it explains	What it does not explain (jurisdictional boundary)
Social Cognitive Theory (Bandura, 1986)	Reciprocal determinism among person, behaviour and environment, together with observational learning and self-efficacy.	The architecture of the model as a whole, and specifically the peer and instructor modelling of food behaviour during practical sessions.	Does not specify why one need takes precedence over another, and does not account for the automatic, non-deliberative component of cue-driven eating.
Hierarchy of Needs (Maslow, 1970)	Prepotency of physiological and safety needs over higher-order esteem needs.	Proposition 5, the direct socioeconomic pathway, and the position of self-esteem as a higher-tier need that is vulnerable when basic needs are precarious.	Makes no claim about how particular eating behaviours are learned, acquired or maintained, and specifies no mechanism of behavioural change.
Classical Conditioning (Pavlov, 1927)	Pairing of a neutral stimulus with an appetitive one, producing conditioned appetitive responding, that is, food cue reactivity.	Proposition 7, the acquisition of cue-driven eating in the training kitchen, and the status of programme of study as a determinant rather than a demographic label.	Does not explain what sustains eating once the conditioned response is established, and has nothing to say about motivation or self-evaluation.
Operant Conditioning (Skinner, 1953)	Strengthening and weakening of behaviour by its consequences, including delay discounting and reinforcer efficacy.	The maintenance and extinction of dietary and activity behaviour, and the asymmetry between immediate reinforcement of consumption and delayed reinforcement of restraint.	Does not explain the antecedent conditioning of appetitive responses, nor the observational and self-evaluative processes that precede consequence learning.

The fourth column is the substantive one. A multi-theory framework earns its complexity only if the boundaries between its components can be stated, because a boundary is what makes it possible to say that a given theory has been misapplied. Each theory here is assigned a jurisdiction and denied the others, and no relationship in the model is explained twice.

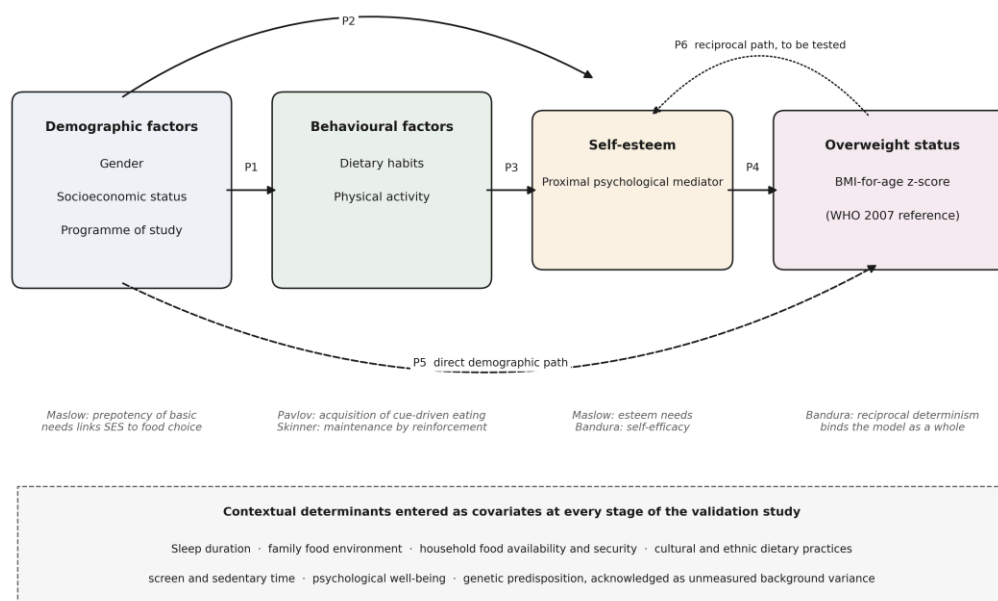


Figure 1. Integrated conceptual framework of obesity-related behaviour among TVET adolescents.

Table 4. Propositions, supporting evidence and strength of the current warrant

No.	Proposition	Supporting evidence	Strength of the current warrant
P1	Gender, socioeconomic status and programme of study are associated with dietary habits and physical activity.	Lai et al. (2024); Tay et al. (2023); Roy et al. (2022)	Moderate. Consistent cross-sectional association in adolescent and student populations; not yet tested in a TVET sample.
P2	Demographic factors are associated with self-esteem.	Jeong et al. (2024); Nisa et al. (2022)	Moderate. Self-perception of weight is patterned by economic status and academic performance; effect sizes vary by setting.
P3	Dietary habits and physical activity are associated with self-esteem.	Gualdi-Russo et al. (2022); Kim et al. (2025)	Moderate. Association well replicated, but direction of effect is not established by the available designs.
P4	Self-esteem is inversely associated with overweight status.	Bjertnaes et al. (2023); Nisa et al. (2022)	Moderate. Longitudinal cohort evidence exists, but it indicates a bidirectional rather than a one-way relationship.
P5	Demographic factors retain a direct association with overweight status independent of the mediated pathway.	Chua et al. (2025); Lai et al. (2024); Santos et al. (2022)	Moderate to strong for socioeconomic status and gender; untested for programme of study.
P6	Overweight status feeds back onto self-esteem, making the relationship reciprocal.	Bjertnaes et al. (2023)	Moderate in a United Kingdom cohort; untested in any Malaysian or vocational sample.
P7	Programme of study moderates the relationship between food-cue exposure and dietary habits.	Boswell and Kober (2022); Musquez and	Limited. The cue-reactivity mechanism is well evidenced experimentally, but the moderation

		Rasmussen (2024); Rodrigues et al. (2023)	has never been tested in a vocational training environment.
P8	Self-esteem mediates only partially, alongside self-efficacy and broader psychological well-being as parallel mediators.	Shahrour et al. (2025); Nesrine et al. (2025)	Untested. Specified here as a competing model to be compared against the single-mediator specification.

Table 4 is the paper's answer to a fair objection: that a conceptual model can present plausible relationships without demonstrating them. None of the eight propositions is presented here as established. Five rest on moderate cross-sectional or cohort evidence drawn largely from non-Malaysian or non-vocational populations, one rests on evidence that is experimentally strong but contextually untested, and one is wholly untested and is offered as a competing specification. The framework's claim is not that these relationships hold, but that they are the relationships worth testing, and that the four theories together explain why each should be expected.

Reading across Table 3 clarifies why no single theory is sufficient. A framework built only on Social Cognitive Theory would capture the reciprocal structure but would underspecify the automatic, cue-driven eating that characterises the training kitchen. A framework built only on conditioning theories would capture the acquisition and maintenance of eating behaviour but would neglect the motivational and self-evaluative dimensions that determine whether a student acts on nutritional knowledge. By combining the four, the framework represents both the deliberate and the automatic components of behaviour, both the motivational and the reinforcing determinants, and both the personal and the environmental sources of influence.

DISCUSSION

The discussion elaborates how each of the four theories explains a distinct segment of the proposed framework, and then demonstrates how the theories combine into a single coherent account. The purpose is to show that the integration is not a loose assembly of ideas but a structured synthesis in which each theory addresses a mechanism that the others do not, while all four converge on the same set of constructs.

Bandura's Social Cognitive Theory and the Personal-Environmental-Behavioural Triad

Bandura's Social Cognitive Theory provides the architectural backbone of the framework through its principle of reciprocal determinism, in which personal factors, behaviour and the environment continuously influence one another (Bandura, 1986). In the context of vocational culinary education this triad is readily observable. Environmental factors such as socioeconomic status, programme of study and the food-saturated learning setting shape the behaviours of dietary intake and physical activity. Personal factors, most notably self-esteem and self-efficacy, influence whether a student chooses to act on nutritional knowledge or to yield to the immediate availability of palatable food. Behaviour, in turn, feeds back into both the environment and the person, as repeated food choices alter the student's habitual environment and self-perception. Systematic reviews confirm that Social Cognitive Theory has been the most frequently applied framework in school-based obesity prevention precisely because it accommodates this reciprocal complexity (Bagherniya et al., 2018).

The theory also supplies the mechanism of observational learning, which is central to a peer-dense educational environment. Adolescents acquire dietary norms by observing and imitating peers and instructors, and the modelling of food behaviour during practical sessions can normalise both healthy and unhealthy patterns. This mechanism explains why the same culinary competence that is associated with healthier eating in the general population (Rodrigues et al., 2023) may not translate into healthier outcomes for culinary students: the observational and environmental pressures of the training kitchen can override individual knowledge. Within the framework, Social Cognitive Theory therefore justifies the pathway from demographic and environmental factors to behaviour, and from behaviour to the personal factor of self-esteem, while establishing the reciprocal logic that binds the whole model together. Recent applications of the theory to adolescent physical activity, in which self-efficacy consistently predicts sustained behaviour, reinforce its suitability for this role (Shahrour et al., 2025).

Maslow's Hierarchy of Needs and the Motivational Foundation of Food Choice

Where Social Cognitive Theory explains the structure of interaction, Maslow's Hierarchy of Needs explains its motivational foundation. Maslow (1970) proposed that human behaviour is organised around a progression of needs, beginning with physiological requirements such as food and safety and ascending toward esteem and self-actualisation. The theory implies that unless basic physiological and safety needs are met, motivation to pursue higher-order goals such as optimal health and positive self-regard is diminished. This logic connects directly to socioeconomic status. Contemporary evidence indicates that adolescents from lower socioeconomic backgrounds are more likely to select inexpensive, energy-dense foods such as instant noodles and sugar-sweetened beverages, because these options satisfy the immediate physiological need for satiety at low cost (Tay et al., 2023). The hierarchy thus offers a principled explanation for the observed association between socioeconomic status and overweight status, and it justifies the direct demographic pathway in the framework.

Maslow's account also clarifies the position of self-esteem within the model. Esteem needs occupy a higher tier of the hierarchy, which means that they are more likely to be satisfied once physiological and safety needs are secure. For a student whose basic needs are precarious, the psychological resources required to maintain self-esteem in the face of weight-related stigma may be depleted, creating a vulnerability that links socioeconomic disadvantage to both low self-esteem and higher body mass index. This interpretation is consistent with cross-sectional findings that low self-esteem accompanies obesity among adolescents (Nisa et al., 2022) and with longitudinal evidence of a reinforcing cycle between psychological distress and body mass index (Bjertnaes et al., 2023). Maslow's theory therefore anchors the mediating role of self-esteem in a motivational rationale, complementing the structural role supplied by Social Cognitive Theory. Prior conceptual work in the Malaysian education literature has similarly drawn on needs-based and motivational framing to explain learner engagement, underscoring the value of motivational theory in this setting (Kamrozzaman et al., 2020).

Pavlov's Classical Conditioning and Food Cue Reactivity in the Training Kitchen

Pavlov's Classical Conditioning contributes the mechanism that is most specific to the culinary vocational context, namely food cue reactivity. Classical conditioning describes how a previously neutral stimulus, through repeated pairing with an unconditioned stimulus, comes to elicit a conditioned response (Pavlov, 1927). Applied to eating, environmental cues such as the aroma of baking, the sight of prepared dishes and the setting of the training kitchen become conditioned stimuli that trigger physiological and behavioural responses, including salivation, craving and food seeking, even in the absence of physiological hunger. Reviews of the neurobiological and behavioural underpinnings of food cue reactivity confirm that such reactivity is reliable and robust in humans, that it can be triggered by cues associated with palatable food through Pavlovian conditioning, and that it is elevated among individuals with overweight and obesity (Boswell & Kober, 2022). Meta-analytic evidence further indicates that food cue reactivity and craving predict subsequent eating and weight gain.

The relevance of this mechanism to culinary and bakery students is direct and substantial. These students are exposed, for extended periods and on a recurring schedule, to precisely the conditioned cues that the literature identifies as drivers of cue-induced eating. Repeated pairing of the training environment with the consumption of palatable food can establish conditioned responses that persist beyond the classroom, contributing to eating in the absence of hunger and, over time, to positive energy balance. This account explains a phenomenon that neither cognitive nor motivational theories fully address: the automatic, cue-driven component of eating that operates below the level of deliberate choice. Within the framework, Classical Conditioning justifies the environmental influence on dietary habits and clarifies why programme of study, specifically enrolment in culinary or bakery programmes, functions as a meaningful demographic determinant of overweight status rather than a neutral background variable.

Skinner's Operant Conditioning and the Maintenance of Behaviour

If Classical Conditioning explains how cue-driven eating is acquired, Skinner's Operant Conditioning explains how eating and physical activity behaviours are maintained or extinguished over time through their consequences. Operant conditioning holds that behaviour followed by reinforcement is more likely to recur, whereas behaviour followed by punishment is less likely to recur (Skinner, 1953). In the vocational setting,

reinforcement takes many forms. The immediate palatability of energy-dense food is a powerful positive reinforcer of consumption, delivered reliably and without delay, whereas the health benefits of restraint and physical activity are delayed and probabilistic, which weakens their reinforcing value. Social reinforcement also operates: a student who receives praise and social support for healthy behaviour experiences reinforcement that increases the likelihood of repetition, while negative experiences such as weight-related teasing can punish and thereby suppress health-promoting behaviour.

This asymmetry between immediate reinforcement of consumption and delayed reinforcement of restraint provides a behavioural explanation for the persistence of overweight status even among students who possess nutritional knowledge. It also identifies a clear point of intervention, because reinforcement schedules can be deliberately restructured. Programmes that provide timely, salient reinforcement for healthy choices, for example through recognition, feedback and peer support, align with operant principles and with evidence that reinforcement-based strategies can shift dietary behaviour. Within the framework, Operant Conditioning justifies the pathway from behaviour to self-esteem, because the reinforcement and punishment a student experiences in relation to eating and activity shape self-evaluation, and it complements Classical Conditioning by explaining the maintenance, rather than merely the acquisition, of obesity-related behaviour.

The reinforcer pathology model offers a contemporary extension of operant logic that is particularly pertinent to the culinary context. This model proposes that the overconsumption of a reinforcer such as food is associated with steep delay discounting, meaning that immediate rewards are strongly preferred over larger delayed ones, and with reduced sensitivity to the effort required to obtain food (Musquez & Rasmussen, 2024). Where food is continuously and effortlessly available, as in the training kitchen, the reinforcing efficacy of food is amplified and the behavioural cost of consumption is minimised. This convergence of high availability, low effort and immediate reward creates conditions under which operant reinforcement of overconsumption is maximised. The framework therefore treats the vocational food environment not as a passive backdrop but as an active reinforcement context that systematically favours energy-dense consumption, which in turn clarifies why environmental restructuring is a necessary component of any intervention derived from the model.

Integrating the Four Theories Into A Coherent Framework

The four theories are complementary rather than competing, and their integration yields explanatory coverage that none achieves alone. Social Cognitive Theory supplies the overall reciprocal structure and the mechanism of observational learning. Maslow's Hierarchy of Needs supplies the motivational foundation that links socioeconomic status to food choice and locates self-esteem within a needs-based logic. Classical Conditioning supplies the acquisition mechanism for cue-driven eating that is specific to the food-rich training environment. Operant Conditioning supplies the maintenance mechanism through which consequences sustain or extinguish behaviour. Mapped onto the constructs of the framework, these mechanisms converge on a single proposition: demographic factors, namely gender, socioeconomic status and programme of study, together with behavioural factors, namely dietary habits and physical activity, influence self-esteem, which in turn influences overweight status, while demographic factors also exert a direct influence on overweight status.

This integration responds to a recognised weakness in the literature, in which theories are applied singly and their combined explanatory potential is left unrealised (Kamrozzaman et al., 2020). By articulating how each theory addresses a distinct mechanism while all four share the same constructs, the framework achieves internal coherence and avoids the eclecticism that often undermines multi-theory models. The framework is also parsimonious in the sense that it does not multiply constructs unnecessarily; instead it assigns each theory to the segment of the model that it explains most convincingly. The result is a structure that is both theoretically grounded and empirically testable.

Self-Esteem as one Candidate Mediator Among Several

The framework places self-esteem at the centre of its psychological layer, and that placement invites a legitimate objection: that adolescent obesity is over-determined, and that elevating a single self-evaluative construct to the status of the mediating mechanism risks a psychological reduction of a phenomenon that is also biological, familial and economic. The objection is accepted, and the framework is specified so as to be vulnerable to it.

Three commitments follow. The first is that mediation is proposed, not assumed. Proposition 4 states a relationship that must be estimated, and Proposition 8 states explicitly that the mediation is expected to be partial. If the indirect effect through self-esteem proves negligible once covariates are entered, the framework is wrong on this point and should be revised rather than defended. The second commitment is that alternative specifications are named in advance and will be tested competitively rather than being introduced afterwards to accommodate an unwelcome result. Two alternatives are specified. In the parallel-mediator model, self-efficacy and general psychological well-being are entered alongside self-esteem, since self-efficacy is the construct that Social Cognitive Theory identifies as proximally governing behaviour (Shahrour et al., 2025) and psychological well-being captures the affective and disordered-eating dimensions that self-esteem scales do not (Nesrine et al., 2025). In the no-mediation model, demographic and behavioural factors act on overweight status directly and self-esteem is treated purely as an outcome. Model comparison will proceed by fit indices and by the significance of the competing indirect effects, not by preference.

The third commitment concerns direction. The strongest available evidence on self-esteem and body mass index in adolescence is longitudinal and describes a cycle rather than an arrow: poorer psychological states and higher body mass index reinforce one another across waves (Bjertnaes et al., 2023). Proposition 6 encodes this reciprocity explicitly, and it cannot be tested in a cross-sectional design. The validation plan therefore treats the cross-sectional phase as capable of estimating association only, and defers any causal claim about self-esteem to the panel phase described in Table 6. A framework that proposes a mediator has an obligation to specify the design that could show the mediation to be spurious, and that obligation is discharged here rather than deferred to a future author.

Operationalisation and Analytic Strategy

A conceptual framework is only as testable as its measurement plan, and a reviewer is entitled to see that plan rather than an assurance that one exists. Table 5 therefore specifies, for every construct in the model and for every covariate identified in Table 1, the indicator to be used, the instrument from which it is drawn, and its measurement level.

Table 5. Operationalisation of constructs and proposed instruments

Construct	Indicator	Instrument or source	Measurement level
Gender	Self-reported sex.	Demographic questionnaire.	Categorical
Socioeconomic status	Monthly household income banded to the national B40, M40 and T20 categories; highest parental education; receipt of institutional financial aid.	Demographic questionnaire, with income bands taken from current national household income classifications.	Ordinal composite
Programme of study	Enrolment in culinary arts or bakery and pastry versus enrolment in a non-food vocational programme.	Institutional enrolment records, verified against student self-report.	Categorical exposure contrast
Dietary habits	Meal frequency, breakfast skipping, sugar-sweetened beverage intake, and consumption of food prepared	Adolescent food habits checklist adapted for the Malaysian TVET context, translated and pre-tested in Phase 1.	Continuous composite

	or handled during practical sessions.		
Physical activity	Activity across the seven days preceding administration, including physical education, transport and leisure activity.	Physical Activity Questionnaire for Adolescents (Kowalski et al., 2004), Malay-language version.	Continuous
Self-esteem	Global self-worth across ten items.	Rosenberg Self-Esteem Scale (Rosenberg, 1965), Malay-language version, with reliability re-established in the study sample.	Continuous
Overweight status	Body mass index for age, derived from directly measured height and weight rather than self-report.	World Health Organization growth reference for school-aged children and adolescents (de Onis et al., 2007).	Continuous z-score, with categorical classification retained for descriptive reporting
Contextual covariates	Sleep duration; family food environment and parental feeding practice; household food security; screen and sedentary time; ethnicity.	Short validated scales and single-item measures, selected in Phase 1 and reported in full in the eventual empirical paper.	Mixed

Two measurement decisions carry particular weight. Anthropometry will be measured directly rather than self-reported, because self-perceived weight diverges systematically from measured body mass index and that divergence is itself patterned by the psychological variables under study (Jeong et al., 2024); using self-report would therefore build the framework's own hypothesis into its outcome measure. All instruments will be translated and back-translated into Malay, reviewed by content experts, and pre-tested in Phase 1, since the reliability coefficients reported for these scales in other populations cannot be assumed to transfer to Malaysian vocational learners.

The analytic strategy follows from the propositions. A confirmatory factor analysis will first establish the measurement model, with composite reliability, average variance extracted and the heterotrait-monotrait ratio reported for discriminant validity. Structural equation modelling will then estimate Propositions 1 to 5 simultaneously, with indirect effects tested by bias-corrected bootstrapping across at least five thousand resamples rather than by the sequential regression procedure, which is now regarded as underpowered for mediation. Proposition 7 will be tested as an interaction between programme of study and food-cue exposure, and Proposition 8 by formal comparison of the single-mediator, parallel-mediator and no-mediation specifications. Measurement invariance will be tested across programme of study and, in the replication phase, across region, since comparing structural coefficients across groups whose measurement model differs would produce differences that are artefacts of instrumentation. A sample of approximately five hundred students is targeted, which satisfies conventional indicator-to-case ratios for a model of this size and provides adequate power for the detection of small indirect effects.

Theoretical, Methodological and Practical Implications

Theoretically, the framework contributes an integrative model to a field that has been dominated by single-theory applications. It demonstrates that the acquisition and maintenance of obesity-related behaviour, the motivational basis of food choice and the reciprocal interaction of person and environment can be represented within one structure without loss of conceptual clarity. This contribution is significant for behavioural nutrition research, where calls for integrative theorising have not always been met with concrete, testable models.

Methodologically, the framework is designed for empirical validation. Its constructs are measurable using established instruments: body mass index for overweight status, validated self-esteem scales for the psychological mediator, and questionnaire measures for dietary habits and physical activity. The proposed relationships can be tested using correlational and regression-based analysis, and the mediating role of self-esteem lends itself to mediation analysis. The framework thus provides a direct bridge from theory to a quantitative research design suitable for a vocational college population in Sabah, and it specifies clear hypotheses concerning both the mediated and the direct pathways to overweight status.

Practically, the framework offers guidance for intervention design in vocational settings. Its four-theory structure implies that effective intervention must address more than knowledge. It must restructure the food environment to reduce conditioned cue exposure, in line with Classical Conditioning; it must realign reinforcement so that healthy choices receive timely and salient rewards, in line with Operant Conditioning; it must attend to basic needs and socioeconomic constraints, in line with Maslow's hierarchy; and it must mobilise observational learning and self-efficacy, in line with Social Cognitive Theory. This multi-pronged implication distinguishes the framework from single-theory models that would recommend only one class of intervention. It is particularly relevant to culinary and bakery programmes, where the training environment itself is a source of risk and therefore a potential site of intervention.

A Staged Plan for Empirical Validation

The framework has not been tested, and the appropriate response to that fact is a plan rather than an assurance. Table 6 sets out five phases, sequenced so that each supplies the precondition for the next. The order matters: estimating a structural model with an instrument whose reliability has not been established in the target population would confound measurement error with structural failure, and comparing regions before invariance has been tested would produce differences that are artefacts of instrumentation rather than findings.

Table 6. Staged plan for empirical validation of the framework

Phase	Design and sample	Purpose and principal output
Phase 1. Instrument adaptation and pilot	Translation and back-translation, expert content validation, and a pilot with approximately eighty to one hundred and twenty students in one Sabah vocational college.	Establishes reliability and construct validity of the Malay-language instrument battery and refines items before full fieldwork.
Phase 2. Cross-sectional validation in Sabah	Stratified random sample of approximately five hundred students across vocational colleges in the Sabah zone, stratified by programme and gender, with directly measured anthropometry.	Tests Propositions 1 to 5 and Proposition 8; estimates indirect effects; compares the single-mediator specification against the parallel-mediator and no-mediation alternatives.

Phase 3. Comparative programme study	Matched comparison of culinary and bakery students with students in non-food vocational programmes within the same institutions, controlling for entry characteristics.	Provides a direct test of Proposition 7 and estimates the contribution of food-exposure to dietary habits and body mass index for age.
Phase 4. Multi-region replication	Replication in at least two further Malaysian zones, analysed through multi-group structural equation modelling with configural, metric and scalar invariance testing.	Establishes whether the framework generalises beyond Sabah and identifies region-specific paths and resource-related boundary conditions.
Phase 5. Longitudinal and intervention testing	A two-wave or three-wave panel across one academic year, followed by a theory-based intervention trial that restructures cue exposure and reinforcement schedules.	Tests Proposition 6 and the direction of the self-esteem relationship, and evaluates whether the framework's multi-theory implications translate into measurable change.

Phases 3 and 4 respond directly to the two scope limitations of the framework. Phase 3 addresses the question of whether food-related training exposure is genuinely consequential, by comparing culinary and bakery students with peers in non-food programmes within the same institutions; without that comparison, programme of study remains a plausible but unverified determinant. Phase 4 addresses geographic scope, since a framework developed with reference to Sabah cannot claim Malaysian generality until its measurement model and structural paths have been shown to hold in other zones. Phase 5 addresses the deepest limitation, namely that a cross-sectional design cannot distinguish a mediator from a correlate, and it is the phase on which any causal reading of the framework must ultimately depend.

Limitations and Directions For Future Research

Four limitations qualify the contribution, and each is stated in the form in which a critic would state it. The first concerns evidential status. The framework has not been tested, and Table 4 shows that its propositions rest on evidence of mixed strength, much of it drawn from populations that are neither Malaysian nor vocational. Two propositions are supported only by mechanism rather than by direct observation in a comparable sample. Readers should treat the model as a research agenda, not as a finding. The second concerns the synthesis procedure. Although the search and selection protocol is reported in full in Table 2, screening and extraction were carried out by a single reviewer without independent duplication, and no formal risk-of-bias appraisal was applied to the retained studies. The synthesis is therefore vulnerable to selection and interpretation bias in a way that a registered systematic review would not be. The grading of evidentiary strength in Table 4 mitigates this risk by making the basis of each claim inspectable, but it does not eliminate it.

The third concerns explanatory scope. As set out in Table 1, the framework models the behavioural and psychosocial layer only. Genetic predisposition is neither measured nor represented, and since common variation is estimated to account for more than twenty percent of variance in body mass index (Locke et al., 2015), a substantial share of the outcome lies permanently outside the model. Sleep, family food environment, food security and cultural dietary practice are entered as covariates rather than theorised, which means the framework controls for them without explaining them. A reader seeking a complete aetiology of adolescent obesity will not find one here, and should not.

The fourth concerns generalisability and design. The framework was developed with reference to culinary and bakery students in Sabah, and its transfer to other TVET programmes, other Malaysian zones or other national vocational systems is an empirical question addressed by Phases 3 and 4 of Table 6 rather than an assumption of the paper. The planned cross-sectional validation, moreover, can establish association but not causal order; the reciprocal relationship encoded in Proposition 6 requires the panel design of Phase 5, and the practical value

of the framework requires the intervention trial that concludes it. Until those phases are complete, the appropriate reading of the model is as a structured and falsifiable hypothesis about a population that has not yet been surveyed.

CONCLUSION

This paper set out to address a clear gap in the literature on adolescent obesity, namely the reliance on single theoretical perspectives that individually capture only part of a complex phenomenon. In response, it constructed an integrated conceptual framework that synthesises Bandura's Social Cognitive Theory, Maslow's Hierarchy of Needs, Pavlov's Classical Conditioning and Skinner's Operant Conditioning to explain obesity-related behaviour among adolescents in Technical and Vocational Education and Training, with particular reference to culinary and bakery students in Sabah, Malaysia. The framework proposes that demographic factors and behavioural factors influence self-esteem, which in turn influences overweight status, while demographic factors also exert a direct influence on overweight status.

The significance of the framework lies in its demonstration that four established theories can be combined into a coherent, parsimonious and testable structure in which each theory explains a distinct mechanism, namely the reciprocal person-environment-behaviour interaction, the motivational basis of food choice, the acquisition of cue-driven eating and the maintenance of behaviour through reinforcement. This integration advances behavioural nutrition theory beyond single-lens application, provides a direct foundation for a quantitative validation study, and yields multi-pronged implications for intervention that are especially pertinent to the food-saturated vocational learning environment. In addressing a population that has been largely absent from the Malaysian obesity literature, the framework also offers a new understanding of how vocational context shapes adolescent health. The framework is nonetheless offered as a hypothesis rather than a result. Its propositions are numbered so that they can be tested separately, its evidentiary basis is graded so that its weakest claims are visible, its scope is declared so that the determinants it does not model are not silently omitted, and its validation is planned in five phases running from instrument piloting in Sabah to multi-region replication and intervention trial. It is by that programme, and not by the coherence of the model alone, that the framework should be judged.

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Conflict of Interest

The authors declare that there is no conflict of interest associated with this study.

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