Identifying key factors that encourage vegetable intake by young adults: using the Health Belief Model

Journal:	*British Food Journal*
Manuscript ID	BFJ-10-2022-0905.R3
Manuscript Type:	Research Paper
Keywords:	vegetable consumption, young adults, Health Belief Model, sustainability, hospitality circular economy

Identifying key factors that encourage vegetable intake by young adults: using the Health Belief Model

Abstract

Purpose: Adequate vegetable consumption is fundamental to a healthy balanced diet; however, global compliance with recommendations is poor which is particularly important for young adults as they form food consumption habits. There is a growing interest in the circular economy of hospitality and sustainability of current dietary patterns in light of climate change and an expanding global population. The food value chain needs to be considered both vertically and horizontally where the R&D investment is optimised by being 'joined up' and not fragmentary; in addition, consumer trade-offs of health vs. for example sensory appeal are taken into consideration. The purpose of this study was to identify factors predicting acceptance of vegetable dishes by young adults and present a roadmap that can be used for dish development and healthful marketing.

Design: This study used the Health Belief Model as framework to investigate key factors that encourage vegetable intake by young adults using an online questionnaire sample of 444 enrolled in undergraduate programs at universities in Brazil.

Findings: Structural modelling showed that vegetable consumption frequency was positively influenced by Health concerns, Naturalness and Self-Efficacy (including cooking skills), whereas Sensory factors and Familiarity demonstrated a negative loading that might be related to unpleasantness.

Originality: Globally, there is a strong need to promote the consumption of vegetables as a public health policy priority but also to ameliorate barriers to action that could be facilitated by availability, dish development and healthful marketing in hospitality operations.

Key words: vegetable consumption; young adults; Health Belief Model; sustainability; hospitality circular economy

Ethics Statement: The project went through full ethical approval within the appropriate institutional committees both in the UK and Brazil.

1. Introduction

Food plays a vital role with regard to health and sustainability in every society. However, there is an urgency to transform it from being a cause of global challenges to one that addresses them. The circular economy and its applicability to service-dominated industries, such as hospitality, is barely considered and poorly researched (Sorin and Klitting, 2021). Population health and the state of the planet rely on a food system that respects planetary boundaries and prioritises societal health. A long-term strategy is therefore essential to create healthy, enjoyable food for all, anchored within environmental parameters (Food, 2030, 2020). The expected 76% rise in the global appetite for meat and animal products by 2050 could increase greenhouse gases by 80% calling for action to mitigate climate change induced by livestock (Food, 2030, 2020). The high resource footprint of producing animal-derived food products is a key factor underpinning a growing interest amongst some consumers for more 'sustainable diets' based upon alternative sources of protein (Bonnet *et al.*, 2020) and a surging interest in the healthy functionality of food (Dias, 2012). There is a large body of evidence surrounding the implications of the current global high levels of meat consumption, with positive correlations between red meat intake and the risk of developing type 2 diabetes (Wurtz *et al*., 2021), cardiovascular disease (Zhong *et al.*, 2020), obesity and some cancers (Lopez-Suarez, 2019). This emerging understanding of the negative implications of meat consumption has led to policy makers becoming increasingly supportive

of a reduction for both health and environmental reasons with strategy advocating diets higher in plant-based products (Willett *et al.*, 2019). Recently, COVID 19 has also focused attention on well-being with 1 in 4 UK consumers cutting down on animal products during the pandemic, and 40% of global consumers considering themselves 'plant forward' and selecting 'climate hero' foods (WGSN, 2022).

There have been a number of studies investigating factors influencing general fruit and vegetable consumption (e.g. Dubé *et al.*, 2019 and Gwozdz *et al.*, 2020) but limited empirical research on vegetables alone especially within hospitality. Riverola *et al.* (2022) conducted a qualitative study on building a greener dining scene and Saulais *et al.* (2019) considered 'Dish of the Day' nudges to increase vegetable selection but more study within the topic is needed. The objective of this research therefore was to further investigate influencing factors on vegetable consumption independently from fruit and discuss how these findings could support sustainable food system development when eating out.

2. Background

It is well established that daily consumption of vegetables is beneficial to human health. Diets high in vegetables have historically held a place in many governments dietary guidelines and are widely recommended for their health promoting properties, due to concentrations of essential nutrients, vitamins, minerals, and dietary fibre (Slavin and Lloyd, 2012). 400g of vegetables per day has been demonstrated to increase life expectancy by 0.4 years (Fadnes *et al.*, 2022) but dietary intakes across the globe do not realise this amount and it is now one of the top 10 risk factors contributing to global mortality, with 1.8 million deaths per year attributable to diets low in vegetables (Global Burden of Disease Study, 2020). Poor dietary behaviours are of significant global concern predominantly for young adults, as habits gained at this time can be taken through to later life.

Notwithstanding, intensifying awareness of climate change and environmental sustainability coupled with health concerns of poor dietary profile is shifting societal norms and many people are now actively reducing their consumption of animal-based products and replacing with plant-based options (Sajeev *et al.*, 2020). This highlights opportunities for credible evidence-based policy interventions within hospitality to further support and promote vegetable intake. A systematic review (Appleton *et al.*, 2018) to identify interventions to increase intake of vegetables as a distinct food group isolated 77 studies, detailing 140 interventions, of which 133 (81 %) were conducted in children. They comprised of interventions aimed to use or change hedonic factors, such as taste, liking and familiarity (n = 72), use or change environmental factors (n = 39), use or change cognitive factors (n = 19), or a combination of strategies (n = 10). Increased vegetable acceptance, selection and/or consumption were reported to some degree in 116 (83 %) interventions, but the majority of effects seem small and inconsistent. From the study it appears that success is currently found from environmental, educational and multi-component interventions, but publication bias is likely, and long-term effects and cost-effectiveness are rarely considered. It is clear that food consumer behaviour is highly complex with many external and internal influences on perception, attitude and action and where a focus on long-term benefits and sustained behaviour change is required. Certain population groups such as young adults are also noticeably absent from the current list of tried interventions (Appleton *et al.*, 2018).

2.1. Factors influencing consumption in young adults

The WHO (2018) advises that developing healthy eating habits in adolescence are the foundation for good health in adulthood. Young adults (18-30 years of age) are an 'at-risk' group for poor dietary behaviours and less healthy food choices (Howse *et al.*, 2018). Young adults can find themselves at a transitory stage in their lives, with an increasing level of independence and identity development, where eating habits are less influenced by parental

food behaviour, and unhealthy dietary habits can prevail. Parental vegetable intake has been shown to be positively associated with adolescents' vegetable consumption (Pearson *et al.*, 2009), yet as this age group move away from the home environment, they are more affected by convenience, peer sociocultural norms, obtaining peer social approval and peer influence (Orben *et al.*, 2020). Studies have found that flatmates had great influence by giving social support and acting as role models towards vegetable consumption (Hartman *et al.*, 2013). Parental food behaviour and friends' social pressure have been considered to have both positive (parents) and negative (friends) influences on individual eating habits in college students (Sogari *et al.*, 2018). Given that it is well documented that young adults as a group have a tendency to make unhealthy food choices which are convenient and that do not meet current dietary recommendations (Poobalan *et al.*, 2014) this is a prime time for intervention to influence positive consumption. Another factor associated with low vegetable consumption is that some have unappealing sensory properties, such as bitter tastes (Dinehart *et al.*, 2006). However, not all are identified in this way and some vegetable dishes could benefit with the addition of a flavoured dip to improve acceptance (Savage *et al.*, 2013). Repeated exposure has been advocated to increase vegetable liking and consumption, as has the use of rewards but effect sizes are small (Appleton *et al.*, 2018; Bernardo *et al.*, 2021). Rodrigues *et al.* (2019), summarises worldwide data regarding vegetable consumption from almost 70 thousand college students. The findings demonstrate that the majority of young adults do not consume vegetables as recommended, or in sufficient quantities to satisfy relevant guidelines. No consumption patterns according to country or region were apparent, although being female was the more frequent predictor associated with a higher intake. Other factors such as normal weight, living in the family home, importance given to healthy eating, higher socioeconomic level, more openness to new experiences i.e., reduced neophobia, greater nutrition knowledge, being more active and drinking less alcohol were all associated with a

higher intake. Availability and familiarity appear to be a key proximal determinant of consumption, especially when the figure for fruit is also added (Rodrigues *et al.*, 2019).

2.2 Health Belief Model

The Health Belief Model (HBM) is one of the most widely used conceptual frameworks in health behaviour research to explain change and maintenance of health-related behaviours (Champion and Skinner, 2008). The model latterly suggests that four constructs can predict health behaviour: perceived risk susceptibility, perceived risk severity, benefits to action and barriers to action. It is intended to be utilised as a guiding framework for health behaviour intentions by assuming that people want to avoid negative health outcomes and that they will adopt behaviours which they believe will protect them from illness.

Perceived risk is assessed according to an individual's perception of his or her susceptibility to the threat. For example, if a young adult has a friend or family member that is suffering from a diet related disease this may heighten their perceived risk of susceptibility (Luquis and Kensinger, 2018). Perceived benefits refer to people's belief about whether a health behaviour they choose to undertake will enable them to manage a health risk. For example, if a person believes consuming more vegetables, will help them lead healthier lives (Smith *et al.*, 2019), maintain a healthy weight and fit their perception of ethically approved choice (Urbanovich and Bevan, 2020), then they are more likely to consider adopting this change. Barriers to action could be poor cooking skills, convenience, mood, and sensory appeal whereas cues to action could be familiarity provided by an enabling environment. Despite there being some studies investigating the application of the HBM on fruit and vegetable consumption (Diddana *et al.*, 2018; Wright *et al.*, 2018), there is limited data related to young adults and the influencing factors on vegetable consumption independently from fruits.

The present study provides valuable insights into how health beliefs may impact eating behaviours for young adults, a population at the crucial stage of transitioning into

independent nutritional practices. Based on the HBM it is hypothesised that an individual's likelihood of eating vegetables is determined by his or her health beliefs that consumption of vegetables will improve overall Health (H2) by emphasising Natural content, (H1) and Weight control (H3), acknowledging benefit i.e., Ethical concerns (H4), whilst overcoming barriers to action, such as Convenience (H5), Familiarity (H6), Sensory appeal (H7), Mood (H8) and Cooking skills (H9) (Figure I). Additionally, it is proposed that where an individual may not always be able to modify a given set of behaviours simply by wishing to do so, their Self-efficacy (H10) may be considered a key intervening factor (Tsai *et al.,* 2021). Self-efficacy refers to an individual's own conviction in his or her ability to make a health-related adjustment in his or her life.

Variables for hypothesis and sociodemographic characteristics for study were selected based on the literature and where, for example, vegetables being high in water and fibre content but low in calories and energy density are beneficial for health and weight control. Research has shown that consumers' perceptions of naturalness are important for the acceptance of foods (Román *et al.,* 2017) as is ethical persuasion based on concerns for the environment. Cooking skills or lack of have been identified as a reason for not preparing vegetables and hence consuming them which can be related to convenience when considering young adults (Rodrigues *et al.,* 2019). Other research has indicated that a high total intake of fruits and vegetables, and some of their specific subgroups including green leafy vegetables, may promote higher levels of optimism and self-efficacy although also could be a barrier if mood is low (Gardner *et al.,* 2014). A positive mood increases the salience of long-term goals such as health, leading to preference for foods such as vegetables whereas a negative mood leads to greater preference for indulgent foods that tend to be processed and high in both fat and sugar (Gardner *et al.*, 2014). Familiarity and sensory appeal were identified in the VeggiEAT project (https://microsites.bournemouth.ac.uk/veggieat/) as important factors related to

consumption (Appleton *et al.*, 2019; Hartwell *et al.*, 2020). Therefore, consistent with the literature, the proposed Health Belief model specification included background factors of naturalness, attitude towards health, weight control, ethical concern, convenience, familiarity, sensory appeal, mood, cooking skills and self-efficacy. These were mapped onto the four constructs of predicting health behaviour namely perceived risk susceptibility, perceived risk severity, benefits to action and barriers to action to elucidate the research aim of investigating key factors that encourage vegetable intake by young adults.

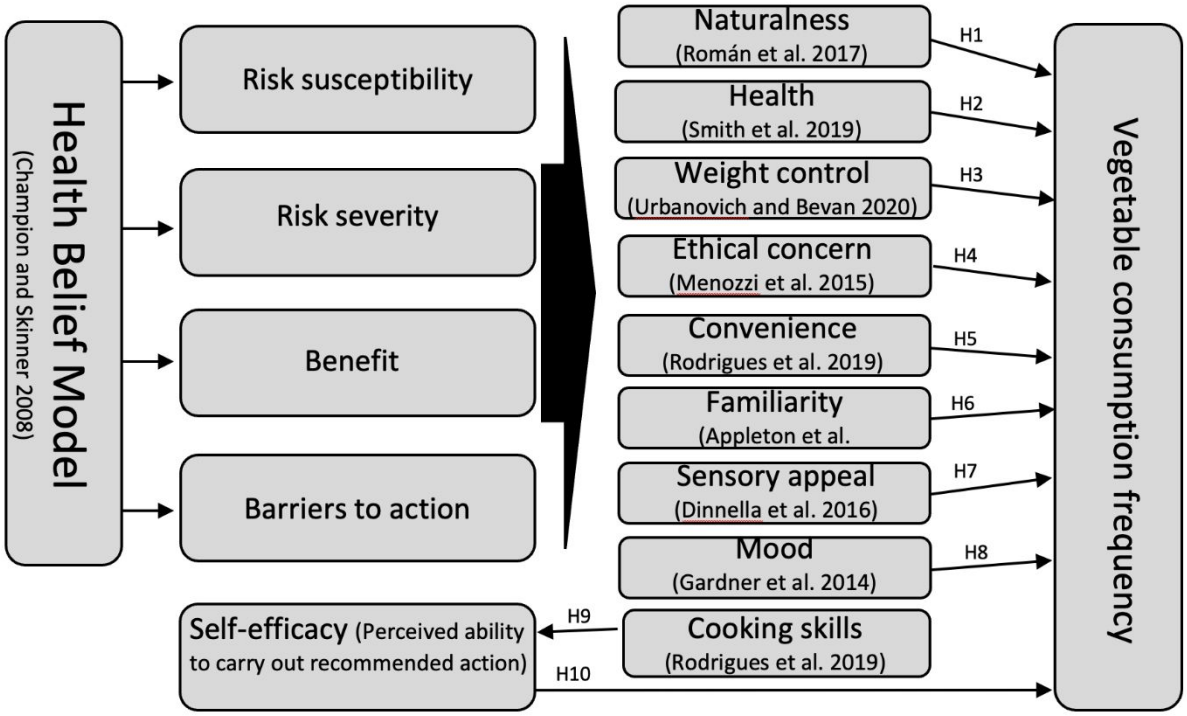


Figure 1: The Health Belief Model as a conceptual framework.

Menozzi *et al*. (2015) taking the Theory of Planned Behaviour to explain vegetable consumption in young adults suggested that, since the most detailed substantial information about the determinants of a given behaviour is contained in a person's behavioural, normative and control beliefs; factors of a personal nature such as mood, attitude to ethical issues and perception of naturalness are expected to influence intentions and behaviour. They propose

that providing factual information on the material consequences of eating vegetables regularly, in particular short-term health implications, may improve consumers' attitude. They also recommended that perceived social pressure could be improved by providing more information about other same age peers behaviour related to vegetable consumption and providing a setting in which social comparison can occur (Menozzi *et al.*, 2015). The Health Belief Model as a framework is ideal for expanding this research. If individuals regard themselves as susceptible to a condition, believe that condition would have potentially serious consequences, believe that a course of action available to them would be beneficial in reducing either their susceptibility to or severity of the condition, and believe the anticipated benefits of taking action outweigh the barriers to (or costs of) action, they are likely to take action that they believe will reduce their risks (Champion and Skinner, 2008).

Dietary change gives substantial health gains for people of all ages and is predicted to be larger the earlier changes are initiated in life. Hence for policy to be effective actions affecting consumption need to focus on influencing variables whilst at a young age and to gain an understanding of the significant predictive relationships between attitudes and behaviours.

3.0 Methodology

3.1 Experimental Design

This research explores the potential for vegetable consumption by developing a causal structural model with 'CONVEGF' (Frequency of Vegetable Consumption) as its outcome and consumer characteristics as predictors. A quantitative methodology was selected as most appropriate to answer the research question and hypotheses. This study expanded and developed results from previous research, i.e., the VeggiEAT project together with a previously validated questionnaire (which included 5 scales from a cross-culturally adapted instrument used with university students in Brazil (Jomori *et al.*, 2017) and a cross-cultural

food choice questionnaire (Heitor *et al.*, 2015). The survey was pilot tested with an initial group of students face to face to confirm that all questions were easy to understand. Internal consistency and reliability were ensured by achieving a Cronbach's α of 0.892. By convention a value above 0.80 is considered a strong reliability test for a scale used in human research (Vaske, 2008). The risk of common method bias was controlled for by giving clear instructions; ensuring anonymity of responses; avoiding complex and ambiguous items and through the concise survey design (Kock *et al.*, 2021).

The survey was distributed online to students aged 18 -30 years enrolled in undergraduate programs at universities in Florianópolis, Brazil. Questions, in order of presentation, consisted of food related lifestyle, e.g., i) availability and accessibility of vegetables; ii) cooking behaviour at home; iii) cooking behaviour away from home; iv) personal attitude towards vegetables; v) self-efficacy for using vegetables and seasonings; vi) self-efficacy on consumption of fresh vegetables; (from Jomori *et al.*, 2017) and vii) motives underlying the selection of food (Heitor *et al.*, 2015). Additionally, socio- demographic characteristics (i.e., age, gender, parental education level) and personal characteristics (i.e., undergraduate course, with whom they live, lunch location, dinner location) were retrieved. Attitudinal questions were presented on a 5 point likert scale where 1 was strongly disagree and 5 strongly agree. A 5 point scale was used to ensure both discriminant results and simplicity of use (Joshi *et al.*, 2015). Previous studies have shown gender differences and living arrangements moderate vegetable intake with more women reporting eating vegetables daily than men and debate regarding the effect of living away from home reducing vegetable consumption (Rodrigues *et al.*, 2019).

All questions were translated from English into Portuguese and then back translated to ensure accuracy and rigour following the procedure and guidelines recommended by Brislin (1993).

Participants were sampled through a snowball sampling technique using both the researchers' initial student contacts and then their networks. This approach involved the researchers initially meeting with a small number of individuals and then requesting that these participants helped to identify their peers who might also complete the survey (Kumar, 2005). Snowball sampling is used successfully to gather a representative sample.

Inclusion criteria comprised students over 18 years old and enrolled on a university programme. Exclusion criteria in analysis comprised of students over 30 years old, the age range of young adults taken as 18-30 years as defined by Howse *et al*. (2018). Power calculation illustrated the minimum sample required was n= 418 considering 10% loss/incomplete, 5% of random error and the inclusion of socio-demographic control variables. A usable sample size of n=444 was achieved.

3.2 Empirical Application

Data analysis comprised descriptive and inferential statistical procedures. Structural Equation Modelling was used to identify and measure the factors predicting Vegetable Consumption Frequency (Izsó *et al.*, 2019).

An unprejudiced conceptual review of the association among measured variables was undertaken to provide a theoretical starting point for the exploratory model of the factors leading to increased frequency of vegetable consumption among young adults. The semantic-theoretical approach to clustering of the measured variables allowed for the development of conceptual terms for each cluster, thereby nominating them reflective indicators of the composite variable conceptually named. Structural variables were required which plausibly confirm that the measured indicators are indicative for the purpose of seeding the structural model which will quantify the regressive links between predictor and predicted; and will serve as an exploratory working hypothesis in operational form. The procedures for validating, testing and optimising the model closely adhered to the guidance of Hair *et al.*

(2017). The quality of the model's terms ensure that only the strengths of the subjective process survive, and the weaker speculations were deleted or respecified. Analysis of the survey was by principal component analysis run in SmartPLS 3 software using the PLS-SEM algorithm as outlined in Hair *et al.* (2017). SmartPLS is a casual modelling approach which optimises the explained variance of the dependant variable and can model both formative and reflective variables (Hair, 2017). Its use was particularly well suited since many antecedent factors were formative, the sample size requirements were met and the complexity of the model could be accommodated (Kumar, 2018). The analysis was conducted to reduce the dimensionality of the large data set and for all tests. Throughout, "significance" implies p =< 0.05.

3.2.1 Assessing and Optimising the Structural (Outer) Model

The aim of this stage was to produce a structural model which ensures that the Latent Variables (LV) generate reliable information for the inner model. The process entailed assessing whether properties of the outer model met criteria of acceptability. According to Hair *et al.* (2017) these properties along with their numerical criteria are as follows: In the case of reflective LV's convergent validity demonstrated magnitude of outer loadings on the parent LV, significant and greater than 0.7, and the average variance extracted (AVE) greater than 0.5. For internal consistency Cronbach's α should be greater than 0.7 and Composite Reliability (CR): between 0.7 and 0.9. To ensure Discriminant Validity of the LVs, indicators of a given LV should load substantially higher than on that LV than on any other LV, the Fornell-Larcker Criterion: square root of AVE should be greater than a given LV's correlation with any other LV and the Heterotrait-monotrait ratio (HTMT): bootstrapped confidence interval for all pairs of constructs should not include 1. To test for collinearity, outer VIFs should be less than 5.

3.2.2 Assessing and Optimising the Inner (Structural) Model

Subject to theoretical oversight, non-significant indicators and regression paths were deleted or reconfigured and if appropriate, specifications of LVs and their indicator sets were adjusted. For this inner model, regression coefficients, endogenous (dependant) LV variance and the effect size of the exogenous LV's should be significant. Probabilities of estimates are derived from 5000 bootstrapped samples. In order to assess the relation direction between the predictor variables and the latent variables confirmatory, Tretrad analysis was conducted following the guidance of Hair et al. (2017). In the final analysis, predictor LVs except HEA are specified as formative. The final model (shown in Figure II) also explores the possibility that CONVEG is better specified as two outcome LVs. This is to distinguish between self-efficacy-promoted consumption, SEFF, and the more general frequency of consumption, CONVEGF; and further to test the dependency SEFF →CONVEGF. Confirmatory Tetrad Analysis also suggests that SEFF is reflective. To test for collinearity, inner VIFs should be lower than 5. For assessment of the model fit we examined SRMR which was less than 0.08 demonstrating an acceptable model fit according to Hu & Bentler (1999).

4.0 Results

A usable sample of 444 was achieved. Of these, 76% were female and mean age was 22.1 ± 3.1 years, 41% were undergraduate students from health-related programmes and most of them (98%) did not have children. Regarding students' cooking habits, 70% reported having between 1 to 3 hours a day to cook at home and 84% considered that they knew how to cook. With regards to the place where meals are usually eaten, 62% said they had lunch away from home. Most respondents consumed vegetables daily (45%) or several times a week (39%), and the main meals in which they included vegetables was lunch (95%). The vegetables consumed more frequently among the sample were carrots (72%), lettuce (59%), tomatoes

(47%) and beetroot (34%). Otherwise, the vegetables they least liked were chayote (35%), rocket (20%), watercress (13%), eggplant (13%) and radish (12%).

Structural modelling was conducted to standardize the range of the continuous initial variables and produce the factors as related to the data regarding vegetable consumption. The initial structural model contained 10 factors measured by survey items, namely, Naturalness (NATUR), Health (HEA), Weight control (WEI), Ethical concern (ETHIC), Convenience (CON), Familiarity (FAM), Sensory appeal (SENS), Mood (MOO), Cooking skills (COO) and Self-efficacy (SEFF).

4.1 Structural Model

Non-significant model parameters (formative relationship acknowledged) included Weight control, Ethical concern, Convenience and Mood and therefore were discarded. As such, the final model contained six latent variables shown to have a significant causal effect on the outcome variable of Vegetable Consumption Frequency. Sampling adequacy was good (KMO=0.87) and fit acceptable (19% of residuals in reproduced correlation matrix >0.05). Self-efficacy (SEFF) has an effect size of 0.503 which demonstrates that just over 50% of the total effect is explained by the relationships outlined, while Consumption of Vegetable Frequency (CONVEGF) has an effect size of 0.231.

Both Self Efficacy (SEFF) and Health (HEA) are found to be reflective constructs. Outer Loadings, and their probabilities are shown in Table I. One Outer Loading does not meet the criterion (heal3 = 0.559) but is retained because it has an important role in explaining the purpose of the construct.

Strictly, four indicators cbh1, sens1,2 & sefv6 should have been omitted as they did not meet the criteria. They have been retained as despite the modest loading cbh1→ COO (0.454) and non-significant but passable loading sefv6→ COO (0.625) sens1→ SENS (0.657) and sens2→ SENS (0.682) they make a substantive contribution to their Latent Variable, sensory

appeal i.e., greater than 0.1 (Hair, 2017). Discriminant Validity of the Latent Variables confirmed by Fornell-Larcker Criterion is shown in Table II.

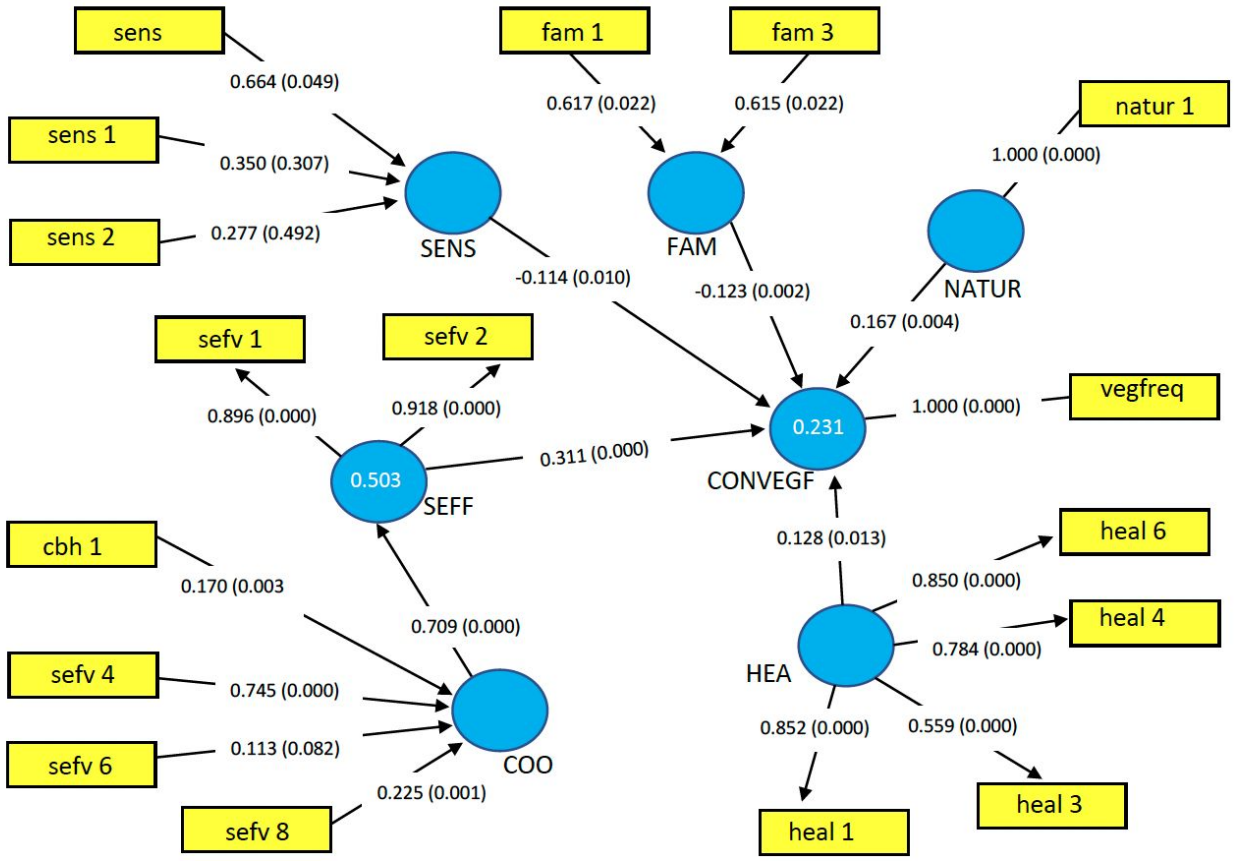
{Insert Table I: Assessment of the Structural (Outer) model here}

{Insert Table II: Discriminant Validity of the LVs confirmed by Fornell-Larcker here}

Criterion (reflective) here}

The final model of effects is shown in Figure II

Figure II. Structural model of vegetable consumption in young adults



Iterative evaluation and revision were undertaken until the structural model met the criteria of acceptability with structural paths being significant (see Table III).

{Insert Table III: Vegetable consumption in young adults outcome Latent Variables and motives underlying food selection here}

Findings in relation to hypothesis testing is summarised in Table IV.

{Insert Table IV: Hypothesis summary here}

Of the 10 Latent Variables identified in the hypotheses; 6, namely Health, Naturalness, Sensory, Familiarity, Cooking skills and Self-efficacy (ability to prepare and consume vegetables) provided significant causal effect on Frequency of Vegetable Consumption. The higher the participant weighting for vegetable "Healthiness" and "Naturalness" and "Self-Efficacy", the higher consumption was likely to be. Whereas "Sensory" and "Familiarity" factors had a negative influence. This may be supported by a notion of extreme taste, unpleasantness of texture and smell which can be associated with some vegetables, as was also found in the VeggiEAT project. The previous within-product research highlighted that independently from familiarity and stated liking, main drivers of actual liking and disliking are the same across countries and ages; sweetness, in opposition to bitterness and sourness (Cliceri *et al.,* 2017; Appleton *et al.,* 2019). The concept of Familiarity is important in that consumers like what they know and eat what they like (Aldridge *et al.,* 2009) however, memory heuristics to food that has previously been eaten or experienced does not discriminate between positive or negative experiences. Our findings demonstrate a negative loading for Familiarity suggesting that in this sample of young adults, previous exposure to some vegetables may have resulted in negative cues to action.

The model identifies that the Frequency of Vegetable Consumption is strongly influenced by Self-efficacy promoted consumption (CONVEGS) which comprises participants knowledge and experience of cooking with vegetables including the use of condiments to enhance taste and palatability. In short, cooking skills are found to have a strongly positive impact on the Frequency of Vegetable Consumption.

5.0 Discussion

It is accepted that there is insufficient vegetable consumption globally from young to old and that there is a disease burden associated with this low intake. While studies have considered

perceptions of freshness, psychosocial, environmental and life course factors influencing fruit consumption, there is very little comparable data on vegetables, and this constitutes an under researched area (Bray and Hartwell, 2017). Notwithstanding, Brazil, a country which is the world's largest beef exporter, has seen a dramatic shift toward plant-based diets. The number of self-declared vegetarians in Brazil has nearly doubled over a six-year period, 30 million people, or 14 percent of Brazilians, reported being vegetarian or vegan in 2018 (Brazilian Institute of Public Opinion and Statistics, 2018). Nevertheless, there is potential to reach out to more of the population especially young adults.

Previous interventions have focused mostly on expanding consumer knowledge on the benefits of increasing their intake of vegetables, based on the assumption that better information would lead to healthier choices. As identified, numerous factors can interfere with this knowledge and a better understanding of these aspects is needed in order to improve the efficiency of public health policies. Initiatives such as Veg City (https://www.vegcities.org/), Peas Please (https://foodfoundation.org.uk/) and Veg Power (https://vegpower.org.uk/) are campaigns to drive up general vegetable consumption, however, as yet young adults as a target population are not considered.

Using the Health Belief Model has enabled us to achieve a better understanding of vegetable consumption and factors which relate to attitude and behaviour. Taking these factors and debating within the four constructs that predict within the HBM, that is, perceived risk susceptibility, perceived risk severity, benefits to action and barriers to action have allowed a more comprehensive understanding of vegetable consumption within young adults. A structured model approach allowed us to test certain hypotheses where the goodness of fit met criteria required and demonstrated minimal discrepancy between observed values and the values expected under the model in question.

The findings provide support that young adults value naturalness (0.167 p=0.004) and perceived benefits to health (0.128 p=0.013). Direction of relationship suggests that nutritional composition, such as increased fibre, and general health are important to young adults. Concerns about health and perceived benefit of healthy eating have been found in previous research as significantly affecting vegetable intake and intentions (Menozzi *et al.*, 2015). Likewise, associations between familiarity and liking or preference have been noted (Appleton *et al*., 2019); however, in this study Familiarity was shown to be negatively related (-0.123 p=0.002), a direction not expected. Sensory as a latent variable was significant however also as a negative value (-0.114 p=0.010) and therefore supports that sensory appeal or lack of is important when considering vegetable consumption amongst young adults. Ethical concern (-0.006 p=0.9) was discarded as were other factors such as convenience (-0.059 p=0.2), weight control (-0.048 p=0.3), and mood (-0.067 p=0.56). Self-efficacy (SEFF) summarises the perceived ease or difficulty of performing a behaviour and was found to strongly influence action in a positive way (0.311 p<0.000), particularly through cooking skills (0.709 p=0.00).

The HBM provides an appropriate framework for consideration of key factors that can encourage young adults to increase vegetable consumption whilst also reflecting consumer attitude trajectory. Glasson *et al.* (2011) directly compared the determinants of fruit and vegetable consumption and indicated that there are significant differences in consumption levels, barriers, knowledge, and stages of readiness (HBM) when fruit and vegetables are considered as separate groups. It is highlighted that health promotion planners and policy makers should consider interventions that focus on improving vegetable consumption in preference to fruit (Glasson *et al*., 2011). This could be in the form of providing factual information on the material consequences of eating vegetables regularly, in particularly for health and the reduction in risk of susceptibility/severity of disease. Findings from the

VeggiEAT project demonstrated a role for liking and a particular concern for health benefits (Appleton *et al*., 2017). Vegetables are considered essential for well-balanced diets since they supply vitamins, minerals, dietary fibre, and phytochemicals (Dias, 2012), notwithstanding compared to fruits they are poorly consumed probably due to many having a bitter sensory profile. In past research (Cliceri *et al.,* 2017; Appleton *et al.*, 2019), highly liked vegetables (carrots, tomatoes, green salad) have been identified, characterized by innately liked tastes (sweet, umami), delicate flavour and bright appealing colour. Other highly disliked vegetables consisted of cauliflower and broccoli, characterized by disliked sensations such as bitter taste and less preferred flavour. The emerging policy for the importance of promoting vegetable products has coincided with a surging consumer interested in healthy eating and other lifestyle changes, which has been highlighted during the COVID pandemic (Mintel, 2021). Evidence from the Nielsen Global Health and Wellness Survey (2015), conducted in 60 countries and involving 30,000 consumers, supports that the most desirable food attributes are freshness, naturalness, and minimal processing with consumers perceiving a close connection between "natural" and "healthy". It is important to consumers that food products are natural as grown and produced in a traditional way and in accordance with nature (Román *et al*., 2017), a profile clearly associated with vegetables. It is also clear that sensory attributes play a part in consumption decision. Nevertheless, this need not be a barrier for vegetable dishes, innovative recipe design can 'disguise' objections and availability promote neophilia (Saulais *et al*., 2019). The presentation of a larger variety of vegetables in hospitality has been shown to positively affect consumption while little variety has been reported as an obstacle (Ensaff *et al.,* 2015). Self-efficacy encompassing frequency of home cooking influences the likelihood of young adult vegetable consumption which can be reinforced by healthful marketing. This research has identified and therefore accepted the hypotheses that positive predicter variables for vegetable consumption are Health (H2),

Naturalness (H1), Cooking skills (H9) and Self-efficacy (H10) whereas Sensory appeal (H7) and Familiarity (H6) are negative dimensions and barriers to overcome.

5.1 Study Limitations

While this study attracted a large sample of young adults, it should be acknowledged that the sample was geographically placed in Brazil notwithstanding the likely generalisability of the results cannot be ignored. The social demographics of our sample identify that these young adults were all of college education. Although care was taken to design the survey tool so as to minimise the risk of common method bias, it's influence cannot be totally excluded. Further research could add confidence that these study findings are applicable to different consumer groups. Several challenges are evident when considering the HBM as a theory to predict health related behaviour (Champion and Skinner, 2008). It couples severity with perceived susceptibility, which is a strength, compared with models that conceptualize threat as a perceived risk alone. However, the relationship between risk and severity in forming a threat is not always clear. In addition, its simplicity alone could be considered a limitation, the HBM is a reductionistic, rational exchange framework which argues that individuals systematically list and weigh the barriers and benefits of a behaviour. This might not always be the case and emotion can be a major influence (Hartwell et al., 2013) hence the inclusion of mood (although discarded as non-significant) within our instrument as a predictor variable.

6.0 Conclusion and implications

Future vulnerability of ecosystems to climate change will be strongly influenced by the past, present and future development of human society, including consideration of the overall sustainability of consumption and production (Intergovernmental Panel on Climate Change, IPCC, 2022). Increasing healthful choices available to consumers (United Nations, 2021) while eating out will impact. Food outside the home accounts for half total food expenditure

(Roberto et al., 2010) and hospitality unlike the food industry has been slow to respond to the emerging agenda of health and sustainability. The competitive nature of the market means that there is a resistance to change and cooperation between companies as an avoidance of risk.

Historically, research programmes within the field have had a unidimensional aspect such as nutrition but this does not take into account the broader issues such as biodiversity, sustainability (with the accompanying muddy legal definition) and consumer science. It means that the academic influence so far to hospitality has been somewhat inadequate, biased towards food waste and missing the rising potential of consideration of the circular economy from a broader aspect. This has been recognised for example by Sodhexo who has developed the Plant+ initiative to be used in universities and publication of our existing research in Playbook for Guiding Diners towards Plant-Rich dishes (WRI.org, 2019). Based on the ecological model for sustainability it has been demonstrated that operational aspects could be successful for example, availability, menu planning and healthful marketing to encourage the consumption of vegetables (Bandoni *et al.*, 2011). From a social ecological perspective, increasing access to affordable fresh fruits and vegetables in communities has shown to encourage both intake and health improvement (Abildso *et al.*, 2019). However, achieving impact requires a step change in food system development minimising reliance on unsustainable use of planetary resources and the promotion of more plant based/vegetable meals. Young adults are at the forefront to build healthier, more sustainable communities which support transformation and achieve the UN Sustainable Development Goals (2015) by 2030. There is a 'bottom up' swell of consumer demand matched by a 'top down' policy drive, towards more healthful consumption. It is clear that now is the time to navigate and act on a compelling evidence base for this societal change. Hospitality environments such as college and university canteens lend themselves to enabling peer to peer settings where good

practice can be exploited. Providing a role model of tasty vegetable dish alternatives could be the answer and a move towards encouraging a hospitality sector that is sustainable, resilient, competitive, diverse, responsible and performant in its provision of accessible, healthy, and sustainable meals.

Funding: This work was funded by an Institutional Links grant, ID 332207684 under the Newton-Brazil Fund partnership.

References:

Abildso, C. G., Bias, T. K. and Coffman, J., 2019, Adoption and Reach of a statewide policy, systems, and environment intervention to increase access to fresh fruits and vegetables in West Virginia. *Transl Behav Med*, 9, (5), 847-856.

Aldridge, V., Dovey, T., Halford, J., 2009, The role of familiarity in dietary development, *Developmental Review*, 29, (1), 32-44.

Appleton, K., Dinnella, C., Spinelli, S., Morizet, D., Saulais, L., Hemingway, A., Monteleone, E., Depezay, L., Perez-Cueto, F.J.A. and Hartwell, H., 2019, Liking and consumption of vegetables with more appealing and less appealing sensory properties: Associations with attitudes, food neophobia and food choice motivations in European adolescents. *Food Quality and Preference,* 75, 179-186.

Appleton, K., Hemingway, A., Rajska, J. and Hartwell, H., 2018, Repeated exposure and conditioning strategies for increasing vegetable liking and intake: Systematic review and

meta-analyses of the published literature. *American Journal of Clinical Nutrition,* 108, (4), 842-856.

Appleton, K. M., Dinnella, C., Spinelli, S., Morizet, D., Saulais, L., Hemingway, A., Monteleone, E., Depezay, L., Perez-Cueto, F. J. A. and Hartwell, H., 2017, Consumption of a High Quantity and a Wide Variety of Vegetables Are Predicted by Different Food Choice Motives in Older Adults from France, Italy and the UK. *Nutrients*, 9, (9).

Bandoni, D. H., Sarno, F. and Jaime, P. C., 2011, Impact of an intervention on the availability and consumption of fruits and vegetables in the workplace. *Public Health Nutr*, 14, (6), 975- 981.

Bernardo, G. L., Rodrigues, V. M., Bastos, B. S., Uggioni, P. L., Hauschild, D. B., Fernandes, A. C., Martinelli, S. S., Cavalli, S. B., Bray, J., Hartwell, H., 2021. Association of personal characteristics and cooking skills with vegetable consumption frequency among university students. *Appetite*, 166, 105432.

Bonnet, C., Bouamra-Mechemache, Z., Réquillart, V. and Treich, N., 2020, Viewpoint: Regulating meat consumption to improve health, the environment and animal welfare. Food Policy, 97.

Bray, J. and Hartwell, H., 2017. The key to eating five fruit and veg a day might just be to make them more tasty. (Online). Available from: https://theconversation.com/the-key-to-eating-five-fruit-and-veg-a-day-might-just-be-to-make-them-more-tasty-75681. [Accessed 15th June 2022].

Brazilian Institute of Public Opinion and Statistics IBOPE, 2018. IBOPE survey shows historical growth in the number of vegetarians in the country. (Online). Available from: https://www.svb.org.br/2473-vegetarians-in-brazil. [Accessed 15th June 2022].

Brislin, R., 1993, Understanding Culture's Influence on Behavior, Harcourt Brace Jovanovich College Publishers, Fort Worth, United States.

Champion V., L., Skinner C., S., 2008, Health Behaviour and Health Education; Theory, Research and Practice. 4th Edition. Chapter 3, p45.

Cliceri, D., Dinnella, C., Depezay, L., Morizet, D., Giboreau, A., Appleton, K., Hartwell, H. and Monteleone, E., 2017, Exploring salient dimensions in a free sorting task: A cross-country study within the elderly population. *Food Quality and Preference*, 60, 19-30.

Dias, J., 2012, Nutritional Quality and Health Benefits of Vegetables: A Review, *Food and Nutrition Sciences*, 3, (10), 1354-1374.

Diddana, T. Z., Kelkay, G. N., Dola, A. N. and Sadore, A. A., 2018, Effect of Nutrition Education Based on Health Belief Model on Nutritional Knowledge and Dietary Practice of Pregnant Women in Dessie Town, Northeast Ethiopia: A Cluster Randomized Control Trial. *J Nutr Metab*, 2018, 6731815.

Dinehart, M.E., Hayes, J.E., Bartoshuk, L.M., Lanier, S. L. and Duffy, V. B., 2006, Bitter taste markers explain variability in vegetable sweetness, bitterness, and intake. Physiology & Behavior. 87, (2), 304-313.

Dubé L., McRaeb, C., Wu, Y., H., Ghosh, M., Allen, S., Ross, D., Sailbal, R., Joshi, K., P., McDermott, J., Jha, S., Moore, S., 2019, Impact of the eKutir ICT-enabled social enterprise and its distributed micro-entrepreneur strategy on fruit and vegetable consumption: A quasi-experimental study in rural and urban communities in Odisha, India, Food Policy, 90, 101787.

Ensaff, H., Homer, M., Sahota, P., Braybrook, D., Coan, S. and McLeod, H., 2015, Food choice architecture; an intervention in a secondary school and its impact on student's plant based food choices, *Nutrients*, 7, 4426-4437.

Fadnes, L., T, Økland J-M, Haaland ØA, Johansson K., A., 2022, Estimating impact of food choices on life expectancy: A modeling study. *PLoS Med* 19, (2): e1003889. https://doi.org/10.1371/journal.pmed.1003889

Food 2030 pathways for action, 2020. Research and innovation policy as a driver for sustainable, healthy, and inclusive food systems. (Online). Available from: https://ec.europa.eu/info/publications/food-2030-pathways-action-research-and-innovation-policy-driver-sustainable-healthy-and-inclusive-food-systems-all_en. [Accessed 15th June 2022].

Gardner, M., P., Wansink, B., Kim, J., Park, S-B., 2014, Better moods for better eating?

How mood influences food choice, *Journal of Consumer Psychology* 24, (3), 320–335.

Glasson, C., Chapman, K. and James, E., 2011. Fruit and vegetables should be targeted separately in health promotion programmes: differences in consumption levels, barriers, knowledge and stages of readiness for change. *Public Health Nutr*, 14, (4), 694-701.

Global Burden of Disease Study, 2020. The Lancet Vol 396 October 17, 2020. (Online). Available from: https://www.thelancet.com/journals/lancet/issue/vol396no10258/PIIS0140-6736(20)X0042-0. [Accessed 15th June 2022].

Gwozdz L. W., Reisch, G., Eiben. M., Hunsberger. K,. Konstabel. E., Kovacs, E., Luszczki, A., Mazur, E., Mendl, M., Saamel, M., Woltes, M., 2020, The effect of smileys as motivational incentives on children's fruit and vegetable choice, consumption and waste: A field experiment in schools in five European countries, *Food Policy,* 96, October 2020, 101852.

Hair, J., Sarstedt M., Ringle C. M., Gudergan S. P., 2017. Advanced Issues in Partial Least Squares Structural Equation Modelling. California: Sage.

Hartman, H., Wadsworth, D.P., Penny, S., van Assema, P., Page, R., 2013, Psychosocial determinants of fruit and vegetable consumption among students in a New Zealand University: Results of focus group interviews, *Appetite*, 65, 35–42.

Hartwell, H., J., Edwards, J., S., A., Brown, L., 2013, The relationship between emotions and food consumption (macronutrient) in a foodservice college setting – a preliminary study,

International Journal of Food Sciences and Nutrition, 64, (3), 261–268.

Hartwell, H., Bray, J., Lavrushkina, N., Rodrigues, V., Saulais, L., Giboreau, A., Perez-Cueto, F. J. A., Moteleone, E., Depezay, L., Appleton, K. M., 2020. Increasing vegetable consumption out-of-home: VeggiEAT and Veg+ projects. *Nutrition Bulletin,* 45, (4) 424-431.

Heitor, S. F., Estima, C. C., das Neves, F.J., de Aguiar, A. S., Castro Sde, S. and Ferreria, J. E., 2015. [Translation and cultural adaptation of the questionnaire on the reason for food choices (Food Questionnaire-FCQ) into Portuguese]. *Cien Saude Colet*, 20, (8), 2339-2346.

Howse, E., Hankey, C., Allman-Farinelli, M., Bauman, A. and Freeman, B., 2018. 'Buying Salad Is a Lot More Expensive than Going to McDonalds': Young Adults' Views about What Influences Their Food Choices. *Nutrients*, 10, (8).

Hu. L, and Bentler, P.M. 1999, Structural equation modelling: cut-off criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. A Multidisciplinary Journal, 6 (1) 1-55.

IPCC, 2022, Summary for Policy Makers, Impacts, Adaptation and Vulnerability (Online). Available from: https://report.ipcc.ch/ar6wg2/pdf/IPCC_AR6_WGII_SummaryForPolicymakers.pdf. [Accessed 15th June 2022].

Izsó, T., Szabó-Bódi, B., Somogyi, L., and Kasza, G., 2019. Consumers' willingness to buy dairy product imitations (analogues) based on structural equation modelling. British Food Journal. 121 (3) 835-848.

Jomori, M.M., Proença, R.P.D.C., Echevarria-Guanilo, M.E., Bernardo, G.L., Uggioni, P.L and Fernandes, A.C., 2017. Construct validity of Brazilian cooking skills and healthy eating questionnaire by the known-groups method. *British Food Journal*, 119, (5), 1003-1016.

Joshi, A., Kale, S., Chandel, S., & Pal, D. K., 2015. Likert Scale: Explored and Explained. British Journal of Applied Science & Technology. 7, (4), 396-403

Kock, F., Berbekova, A., & Assaf A. G., 2021. Understanding and managing the threat of common method bias: Detection, prevention and control. Tourism Management, 86, 104330.

Kumar, R., 2005. Research Methodology: a step-by-step guide for beginners. Sage, London.

Kumar, D. S., & Purani, K., 2018. Model specification issues in PLS-SEM: Illustrating linear and non-linear models in hospitality services context. Journal of Hospitality and Tourism Technology, 9 (3) 338-353.

Lopez-Suarez, A., 2019. Burden of cancer attributable to obesity, type 2 diabetes and associated risk factors. *Metabolism*, 92, 136-146.

Luquis, R. R. and Kensinger, W. S., 2018. Applying the Health Belief Model to assess prevention services among young adults. *International Journal of Health Promotion and Education*, 57, (1), 37-47.

Menozzi, D., Sogari, G., Mora, C., 2015, Explaining Vegetable Consumption among Young Adults: An Application of the Theory of Planned Behaviour, *Nutrients*, 7, 7633-7650; doi:10.3390/nu7095357.

Mintel, 2021, Attitudes towards healthy eating. (Online). Available from: https://reports.mintel.com/display/1069193/. [Accessed 15th June 2022].

Nielsen 2015. Global Health and Wellness Survey. (Online). Available from: https://www.nielsen.com/wp-content/uploads/sites/3/2019/04/january-2015-global-health and-wellness-report.pdf. [Accessed 15th June 2022].

Orben, A., Tomova, L. and Blakemore, S.-J., 2020. The effects of social deprivation on adolescent development and mental health. *The Lancet Child & Adolescent Health*, 4, (8), -640.

Pearson, N., Biddle, S. J. and Gorely, T., 2009, Family correlates of fruit and vegetable consumption in children and adolescents: a systematic review. *Public Health Nutr*, 12, (2), 267-283.

Poobalan, A. S., Aucott, L. S., Clarke, A. and Smith, W. C., 2014, Diet behaviour among young people in transition to adulthood (18-25 year olds): a mixed method study. *Health Psychol Behav Med*, 2, (1), 909-928.

Riverola, C., Dedehayir, O., Harrington, S., Velasquez Franco, S., 2022,

Building a greener dining scene: how do veg-friendly restaurateurs "crop up"? *British Food Journal,* 124, (7), OI: https://doi.org/10.1108/BFJ-10-2021-1104

Roberto, C., Larsen, P., Agnew, H., Baik, J., Brownell, K., 2010, Evaluating the impact of menu labelling on food choices and intake, *American J of Public Health,* 100, 312-318.

Rodrigues, V.M., Bray, J., Fernandes, A.C., Bernardo, G.L., Hartwell, H., Martinelli, S.S., Uggioni, P.L., Cavalli, S.B., da Costa Proença, R.P., 2019, Vegetable consumption and factors associated with increased intake among college students: A scoping review of the last 10 years, *Nutrients*, 11, (7), 1634.

Román, S., Sánchez-Siles, L., Siegristc, M., 2017, The importance of food naturalness for consumers: Results of a systematic review, *Trends in Food Science & Technology,* 67, 44-57.

Saulais, L., Massey, C., Perez-Cueto, F., J., A., Appleton, K., M., Dinnella, C., Monteleone, E., Depezay, L., Hartwell, H., Giboreau, A., 2019, When are "Dish of the Day" nudges most effective to increase vegetable selection? *Food Policy,* 85, 15-27.

Sajeev E., P., M., Martin R., Waite C., Norman M. 2020, Is the UK ready for plant-based diets? Report produced for the Global Food Security Programme. [Online]. Available from: www.foodsecurity.ac.uk/publications. [Accessed 6 July 2021].

Savage, J. S., Peterson, J., Marini, M., Bordi, P. L., Jr. and Birch, L. L., 2013, The addition of a plain or herb-flavored reduced-fat dip is associated with improved preschoolers' intake of

vegetables. *J Acad Nutr Diet*, 113, (8), 1090-1095.

Slavin, J. L. and Lloyd, B., 2012, Health benefits of fruits and vegetables. *Adv Nutr*, 3, (4), 506-516.

Smith, K. S., Raney, S. V., Greene, M. W. and Fruge, A. D., 2019, Development and Validation of the Dietary Habits and Colon Cancer Beliefs Survey (DHCCBS): An Instrument Assessing Health Beliefs Related to Red Meat and Green Leafy Vegetable Consumption. *J Oncol*, 2019, 2326808.

Sogari, G., Velez-Argumedo, C., Gomez, M. I. and Mora, C., 2018, College Students and Eating Habits: A Study Using An Ecological Model for Healthy Behavior. *Nutrients*, 10, (12), 1823.

Sorin, F., and Klitting, H., 2021, Circular economy in the hospitality industry https://www.renewablematter.eu/articles/article/circular-economy-in-the-hospitality-industry, [Accessed 14 October 2022].

Tsai, F.J., Hu, Y.J., Chen, C.Y., Tseng, C.C., Yeh, G.L. and Cheng, J.F., 2021. Using the health belief model to explore nursing students' relationships between COVID-19 knowledge, health beliefs, cues to action, self-efficacy, and behavioural intention: A cross-sectional survey study. *Medicine*, 100, (11).

UN Sustainability Goals, 2015. (Online). Available from: https://sdgs.un.org/goals [Accessed 15th June 2022].

United Nations. UN News 2021, Fruits and vegetables crucial for healthy lives, sustainable world: Guterres. [Online]. Available from: https://news.un.org/en/story/2020/12/1080492. [Accessed 8 July 2021].

Urbanovich, T. and Bevan, J. L., 2020, Promoting Environmental Behaviors: Applying the Health Belief Model to Diet Change. *Environmental Communication*, 14, (5), 657-671.

Vaske, J. J., 2008. Survey research and analysis: applications in parks, recreation and human dimensions. State College, Pa.: Venture.

WGSN 2022. Executive summary. (Online). Available from: https://www.wgsn.com/fd/p/article/87743#page1. [Accessed 15th June 2022].

WHO, 2018. Healthy diet. Fact sheet N°394. (Online). Available from: https://www.who.int/publications/m/item/healthy-diet-factsheet394. [Accessed 15th June 2022].

Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., DeClerck, F., Wood, A., Jonell, M., Clark, M., Gordon, L. J., Fanzo, J., Hawkes, C., Zurayk, R., Rivera, J. A., De Vries, W., Majele Sibanda, L., Afshin, A., Chaudhary, A., Herrero, M., Agustina, R., Branca, F., Lartey, A., Fan, S., Crona, B., Fox, E., Bignet, V., Troell, M., Lindahl, T., Singh, S., Cornell, S. E., Srinath Reddy, K., Narain, S., Nishtar, S. and Murray, C. J. L., 2019, Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet*, 393, (10170), 447-492.

Wright, L., Arce, K. S., Himmelgreen, D. and Epps, J. B., 2018. Farm2Fork: Use of the Health Belief Model to Increase Fresh Fruit and Vegetable Intake Among Food Pantry Participants. *Journal of Hunger & Environmental Nutrition*, 14, (1-2), 252-261.

WRI.org, 2019, Available from: https://www.oneplanetnetwork.org/sites/default/files/from-crm/19_Report_Playbook_Plant-Rich_Diets_final.pdf [Accessed 15th January 2023].

Wurtz, A. M. L., Jakobsen, M. U., Bertoia, M. L., Hou, T., Schmidt, E. B., Willett, W. C., Overvad, K., Sun, Q., Manson, J. E., Hu, F. B. and Rimm, E. B., 2021. Replacing the consumption of red meat with other major dietary protein sources and risk of type 2 diabetes mellitus: a prospective cohort study. *Am J Clin Nutr*, 113, (3), 612-621.

Zhong, V. W., Van Horn, L., Greenland, P., Carnethon, M. R., Ning, H., Wilkins, J. T., Lloyd-Jones, D. M. and Allen, N. B., 2020. Associations of Processed Meat, Unprocessed Red Meat, Poultry, or Fish Intake With Incident Cardiovascular Disease and All-Cause Mortality. *JAMA Intern Med*, 180, (4), 503-512.

Table I: Assessment of the Structural (Outer) model

Latent variable	Composite reliability	Cronbach's α	AVE	Indicator	Item reliability (outer loading)	Outer weights P Values
CONVEGF – frequency of vegetable consumption in young adults			1.000	**vegfreq** - frequency of inclusion of any vegetable in meals		
SEFF – Confidence and ability to prepare and consume (reflective)	0.903	0.785	0.822	**sefv1**- self-efficacy on using fresh or frozen green veg	0.896	
				sefv2 - self-efficacy on using root veg	0.918	
COO – Cooking skills (formative)				**cbh1** - prepare meals from basic ingredients	0.454	0.003*
				sefv4 - self-efficacy on using herbs	0.950	0.000*
				sefv6 - self-efficacy on using vinegars	0.625	0.084
				sefv8 - self-efficacy on using citrus zest	0.646	0.001*
HEA- health related motives underlying the selection of food (reflective)	0.851	0.796	0.594	**heal1** – food contains a lot of vitamins and minerals	0.852	
				heal3 – food is good for my skin/teeth/hair/nails	0.559	
				heal4 – food is high in fibre and roughage	0.784	
				heal6 – food keeps me healthy	0.850	
NATUR- naturalness motives underlying the selection of food	1.000		1.000	**natur1** - food-contains natural ingredients		
FAM- familiarity				**fam1**- food-is familiar	0.813	0.022*

related motives underlying the selection of food (formative)						
				fam3 – familiar food-is what I usually eat	0.811	0.022*
SENS- sensory related motives underlying the selection of food (formative)				**sens** - food-looks nice	0.875	0.044*
				sens1 – food tastes good	0.657	0.299
				sens2 – food has a pleasant texture	0.682	0.497

*=significant at <0.05

Table II: Discriminant Validity of the LVs confirmed by Fornell-Larcker Criterion (reflective)

	CONVEGF	SEFF	COO	FAM	HEA	NATUR
CONVEGF	1.000					
SEFF	0.375	0.907				
COO	0.321	0.709				
FAM	-0.153	-0.056	-0.018			
HEA	0.240	0.141	0.188	0.179	0.771	
NATUR	0.305	0.255	0.289	0.077	0.625	1.000
SENS	-0.125	0.028	0.061	0.431	0.121	0.102

Table III: Vegetable consumption in young adults outcome Latent Variables and motives underlying food selection

Variables	Motives underlying selection	Latent Variable (LV)
vegfreq - frequency of inclusion of any vegetable in meals		the outcome LV CONVEGF – frequency of vegetable consumption in young adults
sefv - confidence using vegetables, and seasonings (self-efficacy)	**sefv1**- self-efficacy on using fresh or frozen green veg	the outcome LV CONVEGS – Confidence and ability to prepare and consume vegetables (self-efficacy).
	sefv2 - self-efficacy on using root veg	the outcome LV CONVEGS
	sefv4 - self-efficacy on using	COO – Cooking skills
	sefv6 - self-efficacy on using vinegars	COO – Cooking skills
	sefv8 - self-efficacy on using citrus zest	COO – Cooking skills
cbh- cooking behaviour at home	**cbh1** - prepare meals from basic ingredients (e.g. whole fresh produce, raw chicken etc)	COO – Cooking skills
heal- health related motives underlying the selection of	**heal1** – food contains a lot of vitamins and minerals	HEA – healthiness
	heal3 – food is good for my skin/teeth/hair/nails	HEA – healthiness
	heal4 – food is high in fibre and roughage	HEA – healthiness
	heal6 – food keeps me healthy	HEA – healthiness
natur- natural content related motives underlying the selection of food	**natur1** - food-contains natural ingredients	NAT – naturalness, natural content
fam- familiarity related motives underlying the	**fam1**- food-is familiar	FAM – familiarity
	fam3 -familiar food-is what I usually eat	FAM – familiarity
sens- sensory related motives underlying the selection of	**sens** - food-looks nice	SEN - Sensory appeal
	sens1 – food tastes good	SEN - Sensory appeal
	sens2 – food has a pleasant	SEN - Sensory appeal

Table IV: Hypothesis summary

Hypothesis	Accepted / Rejected	Directionality	Path coefficient	p-value
H1 Naturalness	Accepted	Positive	0.167	0.004*
H2 Health	Accepted	Positive	0.852	0.000*
H3 Weight Control	Rejected		-0.048	0.306
H4 Ethical Concern	Rejected		-0.006	0.907
H5 Convenience	Rejected		-0.059	0.200
H6 Familiarity	Accepted	Negative	-0.123	0.002*
H7 Sensory Appeal	Accepted	Negative	-0.114	0.010*
H8 Mood	Rejected		-0.067	0.555
H9 Cooking Skills	Accepted	Positive	0.709	0.000*
H10 Self-efficacy	Accepted	Positive	0.311	0.000*

*=significant at <0.05