Understanding, promoting and predicting sustainable diets: A systematic review

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Abstract

Background: The understanding of consumers' behaviours is crucial for developing strategies and educational interventions necessary to transition towards more sustainable diets at the individual and population level. In this regard, social-psychological models can be effective in identifying and understanding the role of the cognitive constructs behind the consumers' behaviour.

Scope and Approach: The present systematic review is aimed at identifying the main drivers and barriers towards the adoption of sustainable dietary behaviours in adult populations. Sixty-seven papers were analysed by applying at least one of the following three theoretical approaches: the Theory of Reasoned Action, the Theory of Planned Behaviour, and the Social Cognitive Theory.

Key Findings and Conclusions: Most of the studies were conducted in industrialised countries and, with one exception, only one among health, environmental, socio-economic and qualitative dietary dimensions was considered in each study. The adoption (or the intention to adopt) a healthy or a low-fat diet was the most analysed. A multitude of significant predictors of intention and behaviour was found. The most recurrent predictors were attitude for intention and intention for behaviour. Social-psychological models can be relevant when applied to dietary behaviour contexts, but present limits in explaining behaviour when prospective and more objective tools to assess food consumption (e.g., food diaries and/or food frequency questionnaires) are used. By identifying the drivers of consumers' behavioural changes, the collected results may support policy makers in providing recommendations and defining primary prevention interventions which enhance consumer awareness and engagement towards more sustainable dietary habits.

Keywords: sustainable diets, eating behaviour, theory of reasoned action, theory of planned behaviour, social cognitive theory

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1. Introduction

The adoption of healthy and sustainable diets together with the transition to sustainable food production systems is urgently needed to counteract the double burden of non-communicable diseases and climate change. Sustainable diets are defined by FAO as "those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources" (Burlingame & Dernini, 2012). By the middle of the century, greenhouse-gas emissions, nitrogen and phosphorous pollution, biodiversity loss, and water and land use are predicted to worsen due to the current dietary trends and the projected population growth. The EAT-Lancet Commission has applied and quantified, at a global scale, the concept of a safe operating space for food system by defining scientific targets to promote human health and a stable Earth system (Willett et al., 2019). An universal healthy reference diet can be defined as a plant-based diet mainly composed of fruits and vegetables, whole grains, pulses, nuts, unsaturated fatty acids, whereas it provides low quantities of fish products and white meat, and no or a low amount of red meat, processed meat, added sugar, refined grains, and starchy vegetables (Willett et al., 2019). In this framework, the investigation and the understanding of consumers' behaviours towards food choices are crucial in defining educational and behavioural interventions to diet transition towards sustainability at an individual and population level. In this respect, a valuable strategy is the application of social-psychological models to identify and understand the cognitive constructs associated to dietary behaviours. Reference drivers and barriers towards sustainable diets could be explored by using three different theoretical models: the Theory of Reasoned Action – TRA (Fishbein & Ajzen, 1975) and its evolution in the Theory of Planned Behaviour – TPB (Ajzen, 1991) together with the Social Cognitive Theory – SCT (Bandura, 1977), on sustainable dietary behaviours. These theoretical frameworks are intended to predict human behaviour as driven by: (i) considerations regarding its likely consequences (behavioural beliefs), (ii) perceived opinions of the social environment (normative beliefs), (iii) individual perceptions of barriers and facilitators existing when attempting to perform the behaviour (control beliefs), (iv) observing others within the context of social interactions, experiences, and outside media influences. These theories have also been proved to be among the most solid theories to ground evidence-based interventions on, including health-related behaviours (Fishbein & Ajzen, 2010). For instance, interventions based on the evidence from TPB studies should be directed at modifying salient beliefs to produce corresponding changes in: attitudes (i.e. beliefs about the consequences of engaging in a certain behaviour and evaluation of these perceived likely outcomes), subjective norms (i.e. perceptions of expectations from significant others and motivation to comply with those perceptions), and perceived behavioural control – PBC (beliefs about the resources and capacity to enact the behaviour). These changes, in turn, may further influence intentions in the desired direction (Fishbein & Ajzen, 2010). Similarly, according to SCT, the behaviour arises from an interdependent interaction between subject-, behaviour- and environment-related factors. Moreover, people are capable of modifying the environment according to their desires. In this

perspective, key SCT concepts are outcome expectations (beliefs about the consequences of performing a behaviour), self-regulation (ability of self-control through goal setting, self-monitoring, self-reward, environmental structuring), observational learning (acquisition of new behaviours via modelling), and self-efficacy (confidence in having skills to perform the behaviour) (McAlister et al., 2008).

As described in the review by McDermott et al (2015a), the characterisation of dietary behaviour can influence the association between the psycho-social theories, such as the TPB, and the behaviour itself. Indeed, the TPB applied to certain eating behaviours referred to discrete food choices (e.g., eating whole grains, or fruit and vegetables, or avoiding fast food) can result in different associations compared to the overall dietary behaviours and patterns (e.g., healthy eating). However, the focus on theoretical models applied to broad eating behaviours is more appropriate when it comes to develop interventions addressed to the health promotion and multiple dimensions of sustainability. Previous systematic reviews have been carried out on TRA/TPB examining healthy and restricted dietary patterns, applying quantitative study designs (McDermott et al., 2015a) and discrete food choice behaviours (McDermott et al., 2015b). To understand how to promote sustainable eating behaviours, a more nuanced investigation of the literature is warranted exploring different theoretical approaches, including also qualitative research, and focusing on sustainable dietary behaviours and patterns. Therefore, the aim of this systematic review was to identify the main drivers of behavioural change towards sustainable diets, intended as comprehensive dietary behaviours not limited to single food choices, by examining scientific contributions that apply TRA, TPB or SCT as theoretical frameworks. In addition, based on the collected data, this systematic review provides useful recommendations for future research and intervention addressed to effectively foster sustainable diets.

2. Methods

This systematic review was carried out following the PRISMA guidelines (Moher, Liberati, Tetzlaff, Altman, & Group, 2009). As the research consists in secondary literature source, no ethical approval was required.

2.1. Study identification

A comprehensive search of the literature was performed in February 2020. Three different electronic databases were used: PubMed, Scopus, and Web of Science. The search queries were differentiated according to the selected databases and composed by a combination of keywords and terms as follows: (“theory of planned behave*” OR “social cognitive theory” OR “theory of reasoned action”) AND (intent* OR attitude* OR eat* OR consumption OR intake OR choice OR habit* OR pattern OR prefer*) AND (diet* OR food OR drink* OR beverage OR nutri* OR snack*). The literature search was extended to records published by February 2020 and included contributions written in English, Italian, Spanish and French. No other temporal or spatial filters were applied to the search. As a consequence, all the articles were considered, independently from the year of data collection or publication.

2.2. Study selection

Two independent researchers assessed the papers using a 3-step strategy, performing data extraction using a standardized form, while discrepancies were solved by discussing with a third party. Firstly, articles were screened for eligibility by title and abstract. Those that met the inclusion criteria were recorded for full-text evaluation and data extraction. The exclusion criteria for article screening and eligibility were indicated as follows: conditions in which the food consumption referred to third parties, transient physiological (e.g., pregnancy, post-partum period), and specific pathological conditions (i.e., cardiovascular diseases, diabetes, and mental disorders) for which cognitive factors of eating behaviour may not be generalizable to the community at large. To retrieve meaningful results for the general healthy adult population, studies where participants were drawn from a specific population (e.g., ictus or cancer survivors, people undergoing haemodialysis, substance users, the homeless) or were not in adulthood (18-65y) were excluded to limit the heterogeneity of the recruited samples. However, if the age range of the recruited sample was not explicitly indicated, but the mean or median age was in the adult range, the paper was retrieved. Studies were not included if: (i) the investigation was addressed to alcohol or dietary supplement intake; (ii) the target behaviour and primary outcome was weight loss or weight loss maintenance; (iii) the dietary behaviour represented a therapeutic treatment (e.g., adopting a gluten-free or Dietary Approaches to Stop Hypertension - DASH diet). With regard to the "dieting" behaviour, a priori exclusion was not performed as different connotations are reported in the reviewed literature. Thus, only the papers which provided a definition of behaviour not consistent with a healthy and sustainable dietary behaviour were excluded (e.g., pills, liquid diet formula, or medications intake to control body weight). Additional exclusion criteria were extended to studies considering just food purchase, from a retailer or at a restaurant, food preparation or food handling without predicting or directly analysing the intention to consume or consumption of more than one food category. The intention or behaviour analysis restricted to the activities prior to the consumption or referring to a single product, meal, food group, or food category may not be adequate in representing the adoption or the intention to adopt a sustainable dietary pattern. For this reason, studies limited merely to fruit and vegetables, cereal-based products, dairy products, meat or fish products were not included. For consistency, sustainable dietary behaviours, such as "avoiding fast food consumption" or "sugared snacks and drinks" were retrieved since they refer to multiple food groups/categories. Due to the relevance of domestic food waste in term of sustainability issues, papers aimed to reduce food waste in the household context, which include the reuse of food leftovers, were included, notwithstanding the exclusion/inclusion criteria already mentioned. Exhaustive details of the screening process can be found in the PRISMA flow-Chart (Figure 1).

2.3. Data extraction

Studies included in this review are peer-reviewed papers describing original investigations that applied three behavioural models (TRA, TPB, and SCT) to sustainable eating behaviours referred to consumption and/or post-consumption activities (i.e. food waste dimension). Distinct attributes of sustainability are considered encompassing the nutritional, environmental and socio-economical dimensions (Burlingame &

Dernini, 2012). For each article included in the review, the following data were recorded: author(s), year of publication, editorial details, aim(s) of the study, study population (sample size, age, gender distribution, period of data collection, socio-demographic characteristics, BMI), research methodology (i.e. qualitative and/or quantitative), applied theoretical model(s), study design, analysed constructs (independent and dependent variables), tools to measure the dietary intake (if applied), the effectiveness of the intervention (if applied), and associations between outcomes and subjects' characteristics.

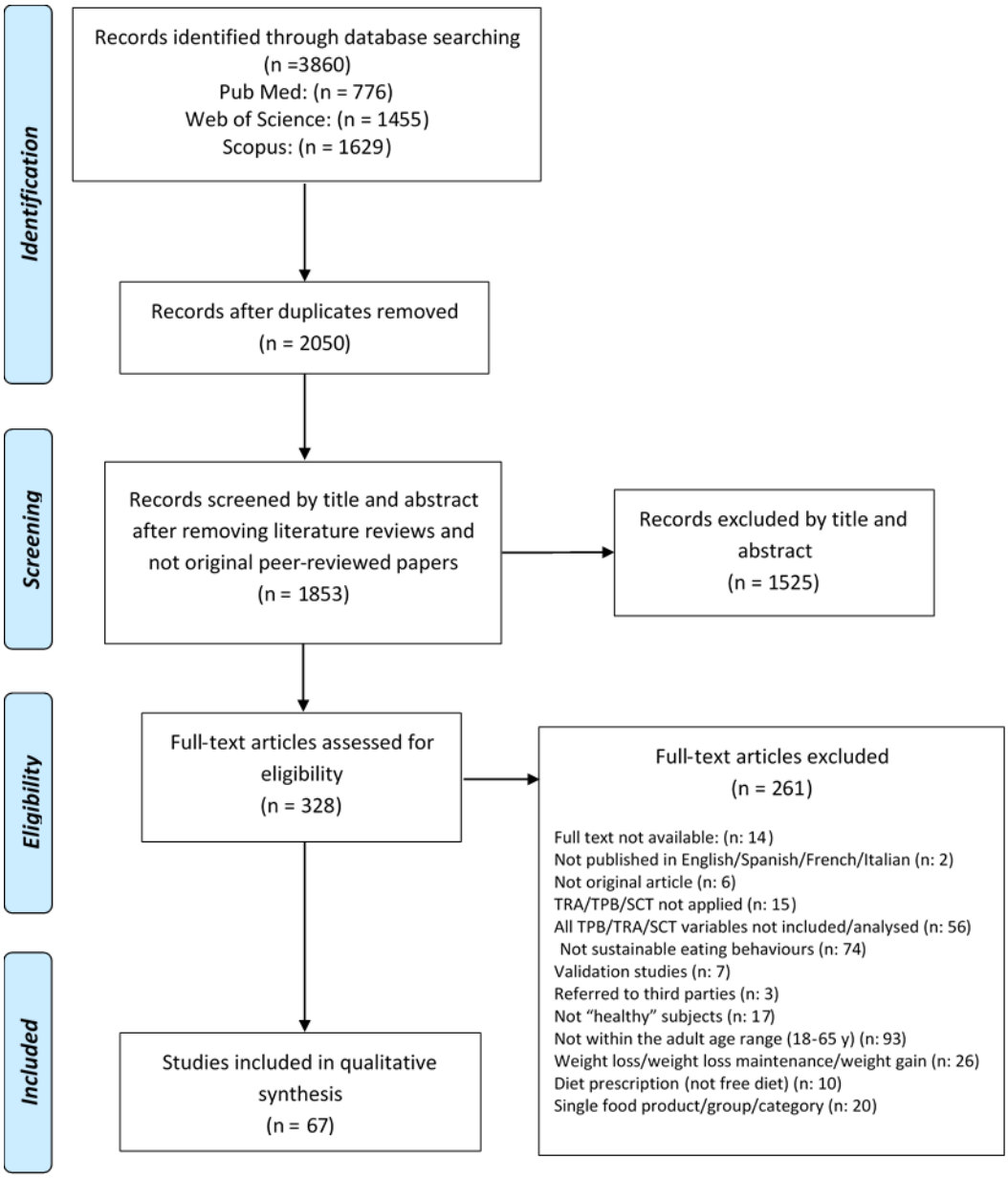

Figure 1. Flow diagram of study selection.

3 Results

A total of 3860 records were identified. After removing 1810 duplicate, 197 reviews and non-original peer-reviewed papers, 1853 studies were screened and 1525 excluded based on title and abstract. From 328

eligible full texts, 67 were finally retrieved including 68 original studies. Table 1 summarizes the totality of the reviewed studies. Most of these studies were conducted in Western industrialised countries, primarily Europe, USA and Canada (n=54), followed by Asia (n=6), Latin America and Caribbean (n=4), Australia (n=3) and Sub-Saharan Africa (n=2), with some of them carried out in two nations. The majority of the investigations were conducted in high income countries (88%), while only a small proportion refers to upper-medium (7%), low (3%) or lower-medium (1%) income countries (World Bank Classification, 2017).

Table 1. Summary of the studies included in the systematic literature review.

Authors (year)	Country(ies)	Applied model(s)	Sustainability dimension(s)
Ajzen & Sheikh (2013)	USA	TPB	Health (avoiding fast food consumption)
Alexander *et al.* (2018)	USA	Mixed models	Health (healthy eating)
Armitage & Conner (1999)	UK	TPB	Health (following a low-fat diet)
Armitage *et al.* (1999)	UK	TPB	Health (following a low-fat diet)
Åstrøm & Rise (2001)	Norway	Extended TPB	Health (healthy eating)
Ates, 2019 (2019)	Turkey	Extended TPB	Health (healthy eating)
Bassett-Gunter *et al.* (2015)	Canada	TPB	Health (healthy eating)
Bassett-Gunter *et al.* (2013)	Canada	TPB	Health (healthy eating)
Bebetsos (2002)	Greece	TPB	Health (healthy eating)
Bhatti *et al.* (2019)	Pakistan	Extended TPB	Environmental (avoiding food waste)
Blue (2007)	USA	TPB	Health (healthy eating)
Brouwer & Mosack (2015)	USA	Extended TPB	Health (healthy eating)
Byrd-Bredbenner *et al.* (2011)	USA	SCT	Health (healthy eating)
Carrete and Arroyo (2014)	Mexico	Mixed models	Health (healthy eating)
Chevance *et al.* (2017)	France	TPB	Health (healthy eating)
Close *et al.* (2018)	USA	TPB	Health (healthy eating)
Conner *et al.* (2003)	UK	TPB	Health (healthy eating)
Conner *et al.* (2000)	UK	TPB	Health (following a low-fat diet)
de Bruijn *et al.* (2008)	Netherlands	TPB	Health (reducing SFA consumption)
de Gavelle et al. (2019)	France	TPB	Health + environmental (reducing meat intake)
Goodwin & Mullan (2009)	Australia	TPB	Health (eating food with low GI)
Hagger & Chatzisarantis (2006)	UK	TPB	Health (dieting)
Hagger *et al.* (2007)	UK	TPB	Health (dieting)
Hagger *et al.* (2006)	UK, Malaysia	TPB	Health (dieting)
Karpinski & Milliner (2016)	USA	TPB	Health (healthy eating)
Kim & Hall (2019)	South Korea	Extended TPB	Environmental (reducing food waste)
Krummel *et al.* (2002)	USA	SCT, HBM	Health (eating a heart-healthy diet)
Kvaavik *et al.* (2005)	Norway	TPB	Health (healthy eating)
La Barbera *et al.* (2016)	Italy	TPB	Environmental (reducing food waste)
Lin (2013)	Taiwan	TPB	Environmental (following a eco-friendly diet)
Liou and Bauer (2007)	USA	Mixed models	Health (reducing obesity risk)
Liou *et al.* (2014)	USA	Mixed models	Health (reducing obesity risk)
Liou *et al.* (2011)	USA	Mixed models	Health (reducing obesity risk)
Lv and Brown (2011)	USA	TPB	Health (increasing calcium intake)
Manios *et al.* (2007)	Greece	Mixed models	Health (preventing osteoporosis)
Masalu & Åstrøm (2003)	Tanzania	TPB	Health (avoiding sugared snacks/drink)
Masalu & Åstrøm (2001)	Tanzania	TPB	Health (avoiding sugared snacks/drink)
McGee *et al.* (2008)	USA	SCT	Health (healthy eating)
Memon *et al.* (2019)	Malaysia	TPB	Socio-economic (consuming local food)
Mondéjar-Jiménez *et al.* (2016)	Italy, Spain	TPB	Environmental (reducing food waste)
Mullan and Xavier (2013)	Australia	TPB	Health (reducing SFA consumption)
Nguyen *et al.* (1996)	Canada	TPB	Health (following a low-fat diet)
Nguyen *et al.* (1996)	Canada	TPB	Health (following a low-fat diet)
Onwezen *et al.* (2014)	Netherlands	Extended TPB	Food quality (consuming organic food)
Onwezen *et al.* (2014)	Netherlands	Extended TPB	Socio-economic (consuming fair trade food)
Øygard & Rise (1996)	Norway	TPB	Health (healthy eating)
Pawlak *et al.* (2009)	USA	TPB	Health (healthy eating)
Paisley & Sparks (1998)	UK	TPB	Health (following a low-fat diet)
Paisley *et al.* (1995)	UK	TPB	Health (following a low-fat diet)
Peng (2009)	USA	Mixed models	Health (healthy eating)
Povey *et al.* (2007)	UK	TPB	Health (healthy eating)
Romeike *et al.* (2016)	Netherlands	Mixed models	Health (healthy eating)

Table 1. *Cont*.

Authors (year)	Country(ies)	Applied model(s)	Sustainability dimension(s)
Ruhl *et al.* (2016)	USA	Mixed models	Health (healthy eating)
Vayro & Hamilton (2016)	Australia	TPB	Health (limiting discretionary choices)
Visschers *et al.* (2016)	Switzerland	TPB	Environmental (avoiding food waste)
von Meyer-Höfer *et al.* (2015)	Germany, Chile	TPB	Food quality (consuming organic food)
Russell *et al.* (2017)	UK	Mixed models	Environmental (reducing food waste)
Sánchez *et al.* (2019)	Mexico	TPB	Health (healthy eating)
Saunders & Rahilly (1990)	USA	TRA	Health (dieting)
Shukri *et al.* (2016)	UK	TPB	Health (following a low-fat diet)
Strong *et al.* (2008)	USA	SCT	Health (healthy eating)
Sumodhee & Payne (2016)	UK	TPB	Health (healthy eating)
Swindle *et al.* (2018)	USA	SCT	Health (healthy eating)
Tami *et al.* (2012)	USA	SCT	Health (dietary behaviour)
Thomas & Mcintosh (2013)	USA	TPB	Socio-economic (consuming local food)
Tull *et al.* (2013)	Barbados	TRA	Health (healthy eating)
White *et al.* (2010)	USA	Mixed models	Health (healthy eating)
Wyker & Davison (2010)	USA	Mixed models	Health (following a plant-based diet)

GI: glycaemic index; HBM: Health Belief Model; SCT: Social Cognitive Theory; SFA: saturated fatty acids; TPB: Theory of planned behaviour; TRA: Theory of Reasoned Action.

The original or an adapted model of TRA, TPB and SCT were applied respectively in 2, 48 and 5 studies, while 13 papers referred to a combination of different behavioural models (Table 2). Due to the broad extension of the sustainability concept, several investigation objectives were observed, even though most of the reviewed studies refer to the health dimension (n=56/68), which was evaluated in the context of a general (i.e. healthy eating) or restrictive behaviour (e.g., reducing sugar and/or fat intake, increasing calcium intake, incorporating glycaemic index into dietary behaviour, avoiding fast food). The other sustainability dimensions included socio-economic issues (e.g., local food, fair trade food consumption), food quality (i.e. organic food) and food environmental dimension (e.g., engagement in pro-environmental behaviours such as the adoption of plant-based diets, or reduction of household food waste). Only one study addressed both health and environmental dimensions including TPB-items referred to health and environmental consequences associated to the adoption of a low-meat diet (de Gavelle et al., 2019). The study population included heterogeneous subjects with different health status and socio-economic conditions (e.g., age, income). They ranged from healthy subjects to individuals at risk for coronary heart diseases or diabetes, as well as overweight and obese people. Various study designs were applied, ranging from observational – cross-sectional or prospective – to intervention studies. The applied methodology included qualitative and/or quantitative research approach. A summary table of all reviewed studies is reported in the Supplementary File 1.

Table 2. Quantification of the reviewed studies according to the applied theoretical model(s) and study design.

	Quantitative			Qualitative	Quantitative + Qualitative		Total
	CS	P	I	CS	CS	I	
Theory of Reasoned Action	2						2
Theory of Planned Behaviour	30	13	1	4			48
Social Cognitive Theory	2			2	1		5
Mixed models	4	1	1	6		1	13
Total	38	14	2	12	1	1	68

CS: cross-sectional; P: prospective; I: intervention.

Overall, when TPB was applied, attitude and PBC, followed by subjective norms, resulted the most recurrent significant intention predictors (Table 3). Furthermore, in the framework of the health dimension, attitude resulted the most important intention predictor more frequently compared to others variables. Indeed, it recurred as one in 12 out of a total of 29 models, while subjective norms and PBC recurred as the most important predictors in 9 out of 25 and 7 out of 23 models. Within the environmental category, attitude was distinguished into personal, moral and financial attitude, with the latter never recurring as the most important predictor, unlike the former. Overall, subjective norms were faceted in injunctive, descriptive and personal norms. The former occurred as the most important predictors in a total of 15 out of 33 models, across all the psycho-social theories considered, while the latter were the most predictive in only one TPB model. Among the other significant predictors, self/role identity and past behaviour resulted to be particularly relevant as recurred in 6 and 4 studies in the health category and were the most predictive respectively in 5 of 7 and 2 out of 4 models.

Table 3. List of significant predictors of behavioural intention (BI) and the relative recurrence found in the reviewed studies.

	Significant predictors of BI	Sustainability Dimension	Recurrence	Recurrence as the most important predictor
TRA	Attitude	H	2/2	1/3
	Subjective norms	H	2/2	2/3
TPB	Attitude	H	19/34	12/29
		E	3/5	none
		H+E	1/1	1/1
		S	2/2	none
		FQ	2/2	2/3
	Affective attitude	H	1/34	2/2
	Personal attitude	E	1/5	1/1
	Financial attitude	E	1/5	none
	Moral attitude	E	1/5	1/1
	Subjective norms	H	15/34	9/25
		E	1/5	1/1
		H+E	1/1	none
		S	1/2	1/1
		FQ	1/2	1/2
	Injunctive norms	H	1/34	none
		E	1/5	1/1
		S	1/2	none
		FQ	1/2	none
	Descriptive norms	S	1/2	1/1
		FQ	1/2	none
	Personal norms	H	1/34	1/1
		E	1/5	none
	Perceived behavioural control	H	19/34	7/23
		E	4/5	1/4
		S	2/2	none
	Perceived power of the control factor	H	1/34	none
	Self-efficacy	H	1/34	none
	Perceived health risks	E	1/5	none
	Anticipated affect	H	1/34	1/1
	Self-/Role identity	H	6/34	5/7
	Past behaviour	H	4/34	2/4
	Social physic anxiety	H	1/34	none
	Physical self-concept	H	1/34	none
	Skills	H	1/34	NA
	Outcome evaluation	H	1/34	NA
	Altruistic/egoistic motives	FQ	1/2	none

Table 3. *Cont*.

	Significant predictors of BI	Sustainability Dimension	Recurrence	Recurrence as the most important predictor
TPB	Scepticism	FQ	1/2	none
	Concern about FW	E	1/5	none
	Use of bio waste container	E	1/5	none
	Guilt	E	1/5	none
		S	1/2	none
		FQ	1/2	none
	Pride	E	1/5	none
		S	1/2	none
	Job demand	H	1/34	none
	Gender	H	1/34	none
	Work interference with family	H	1/34	none
MIXED MODELS	Attitude	H	2/5	2/5
	Subjective norms	H	1/5	1/1
		E	1/1	none
	Perceived behavioural control	H	1/5	1/1
		E	1/1	1/1
	Perceived benefits	H	1/5	none
	Self-efficacy	H	1/5	1/2
	Nutritional Knowledge	H	1/5	none
	Willingness	H	1/5	1/1
	Negative emotions	E	1/1	none

Note: *Recurrence* is expressed as the ratio between the number of reviewed studies analysing each significant intention predictor and total number of studies distinguished by sustainability dimension(s). *Recurrence as the most important predictor* is expressed as the ratio between the number of psycho-social models in which each significant predictor resulted as the most predictive (due to the most relevant regression coefficient towards intention) and the total number of models analysing each predictor in each sustainability dimension. The numerator in *Recurrence* does not equal the denominator in *Recurrence as the most predictive* if multiple models were applied in a single study (e.g., Saunders & Rahilly, 1990). BI: behavioural intention; E: environmental; FQ: food quality; H: health; S: socio-economic; SCT: Social Cognitive Theory; TPB: Theory of Planned Behaviour; TRA: Theory of Reasoned Action.

Overall, the number of studies providing one or more regression analyses on behaviour as dependent variable was lower compared to those analysing only intention. Within the significant predictors of behaviour, intention was the most recurrent (Table 4). However, past (frequently intended as actual) behaviour in cross-sectional studies and baseline behaviour in longitudinal investigations recurred as the most important predictors in each model they were used (14 out of 14).

Table 4. List of significant predictors of behaviour (B) and the relative recurrence found in the reviewed studies.

Significant predictors of B	Sustainability dimension	Recurrence	Recurrence as the most important predictor
	E	3/4	2/3
	H+E	1/1	none
	S	1/1	none
	FQ	2/2	2/3
Attitude	H	2/18	none
	FQ	1/2	none
Financial attitude	E	1/4	none
Subjective norms	H	1/18	none
	E	1/4	1/1
Personal norms	E	1/4	none

	Perceived social norms	H	1/18	none

Table 4. *Cont*.

	Significant predictors of B	Sustainability dimension	Recurrence	Recurrence as the most important predictor
TPB	Perceived behavioural control	H	10/18	4/13
		E	2/4	none
		H+E	1/1	1/2
		S	1/2	none
	Skills	H	1/18	NA
	Control beliefs	H	1/18	1/1
	Self-efficacy	H	1/18	none
	Self-/Role identity	H	2/18	2/2
	Good provider identity	E	1/4	none
	Past/baseline behaviour	H	5/18	14/14
	Price	FQ	1/2	none
	Scepticism	FQ	1/2	none
	Marketing/sale strategies addiction	E	1/4	none
	Information	FQ	1/2	1/1
	Interaction	H	1/18	none
	Education	H	1/18	none
	Household income	H	1/18	1/1
	Marital status	H	1/18	none
	Gender	H	1/18	none
		E	1/4	none
	Age	H	1/18	none
	Children at home	E	1/4	none
	More than 2 adults at home	E	1/4	none
	Number of cigarettes/day	H	1/18	none
SCT	Childhood healthy food intake	H	1/1	1/1
MIXED MODELS	Intention	H	2/2	5/9
		E	1/1	none
	Cues to action	H	1/2	none
	Perceived benefits	H	1/2	1/4
	Self-efficacy	H	1/2	7/11
	Willingness	H	1/2	1/1
	Past behaviour	E	1/1	1/1
	Negative emotions	E	1/1	none

Note: *Recurrence* is expressed as the ratio between the number of reviewed studies analysing each significant behaviour predictor and total number of studies predicting behaviour distinguished by sustainability dimension(s). *Recurrence as the most important predictor* is expressed as the ratio between the number of psycho-social models in which each significant predictor resulted as the most predictive (due to the most relevant regression coefficient towards behaviour) and the total number of models analysing each predictor in each sustainability dimension. The numerator in *Recurrence* does not equal the denominator in *Recurrence as the most predictive* if multiple models were applied in a single study (e.g., Armitage et al. (1999). B: behaviour; E: environmental; FQ: food quality; H: health; S: socio-economic; SCT: Social Cognitive Theory; TPB: Theory of Planned Behaviour.

A wide range of explained variance (R^2) in behavioural intention and behaviour was observed when TPB and mixed models were applied (Table 5). Overall, TPB models referred to the health dimension explain more than half of the explained variance of behavioural intention (median R^2: 59%), with a minimum of 19% and a maximum of 77% in cross-sectional studies, and a minimum of 41% and a maximum of 87% in the longitudinal ones. As TPB and health dimension were the most frequently analysed models and behaviours, a relatively higher number of intention measurements was observed (respectively, n=17 cross-sectional, and n=14 longitudinal). When sustainability dimensions and theoretical models other than health

and TPB were considered, a lower number of measurements in intention (n=1-3) and behaviour (n=1-8) were found. In general, the explained variance in behaviour was lower compared to intention. Distinguishing the method used to collect dietary intake as a measure of behaviour, different R^2 range were observed. Low percentages (<20%) were reported when more objective behaviour assessments were performed (e.g., using food records or food frequency questionnaires *vs.* self-perceived behaviour), excepting for the study by Conner and colleagues (2003) who reported a high explained variance (61% and 81%) in two subsamples of general population recruited in England. In this case, eating behaviour was assessed both with self-reported measure (20 items), and by applying a food frequency questionnaire (33 items).

Table 5. Explained variance (percentages: median, minimum and maximum R^2), and number of measurements (n.), referred to the dependent variables (outcome measures) in the different reviewed models.

	Sustainability dimension	Cross-sectional studies				Longitudinal studies				
		Outcome measure	n.	R^2 median	R^2 min-max	Outcome measure	n.	R^2 median	R^2 min-max	Time gap
TRA	H	BI	2	30	19-41	BI	-	-	-	
		B	-	-	-	B/Ex/SE	-	-	-	-
TPB	H	BI	17	59	19-77	BI	14	59	41-87	
		B (FFQ)	3	27	10-65	B (FR)	2	15	14-16	1 week - 8years
		B (SP)	1	47	-	B (SP+FFQ)	3	61	33-81	
		B (NAQ)	2	5.5	3-8	B (FFQ)	7	11	4-37	
		Ex	1	39	-	B (SP)	8	43	30-66	
	H+E	BI	1	51	-	BI	-	-	-	-
		B (FFQ)	1	15	-	B/Ex/SE	-	-	-	-
	FQ	BI	2	44	32-56	BI	-	-	-	
		B (FFQ)	1	48	-	B/Ex/SE	-	-	-	-
		B (SP)	2	35	17-53					
	E	BI	3	38	5-61	BI	-	-	-	
		B (SP)	3	22	44-33	B/Ex/SE	-	-	-	-
	S	BI	1	39	-	BI	-	-	-	
		B/Ex/SE	-	-	-	B (FFQ)	1	9	-	1 week
SCT	H	BI	-	-	-	BI	-	-	-	
		B (SP)	1	8	-	B/Ex/SE	-	-	-	-
		SE	1	26	-					
		Ex	1	8	-					
MIXED	H	BI	3	41	7-61	BI	-	-	-	
		B (SP)	2	25.5	20-31	B/Ex/SE	-	-	-	-
	E	BI	1	61	-	BI	1	29	-	
		B/Ex/SE	-	-	-	B (SP)	1	46	-	14 month

Note: R^2 data are expressed as median values if more than one measurement is reported, and are shown distinguishing the study design (i.e., cross-sectional and longitudinal), the applied theoretical approach and the sustainability dimension. Time gap refers to the temporal lag between intention and behaviour measurement. B: behaviour; BI: behavioural intention; E: environmental; FFQ: food frequency questionnaire (29-180 items); Ex: expectations; FQ: food quality; FR: food records (3-4 days); H: health; NAQ: nutritional adequacy questionnaire; S: socio-economic; SCT: social cognitive theory; SE: self-efficacy; SP: self-perceived behaviour; SR: self-reported healthy eating behaviour; TPB: theory of Planned Behaviour; TRA: Theory of Reasoned Action.

The results are displayed in the following paragraphs, subdividing by the applied theoretical framework, the study design and the targeted sustainability dimension. In addition, a summary of the main strengths and limitations emerged from the reviewed studies is reported in Table 6.

3.1 Original TRA model

The original TRA model was applied in 2 cross-sectional quantitative studies, which independently investigated the intention to consume fruit, nuts, and vegetables in Barbadian women (Tull et al., 2013), and the intention to reduce sugar and fat intake in college students enrolled in health courses in USA (Saunders & Rahilly, 1990). The TRA model explained respectively 19% and 41% of the variance in intention to engage in the behaviour. In the latter study (Saunders & Rahilly, 1990), higher percentages were found when the students were split in health majors (45%) – who were studying to become health professionals – and non-health majors (47%). Both attitude and subjective norms were significant predictors, with family playing a major role in affecting dietary intentions in the female sample living in West Indies (Tull et al., 2013). Conversely, attitude was more influential than subjective norm in predicting behavioural intention in the subsample of health majors (Saunders & Rahilly, 1990), indicating a higher relevance of beliefs and values compared to social influences in health majors than in the counterpart. The authors (Saunders & Rahilly, 1990) suggest that the higher degree of awareness about the positive consequences of healthy nutritional behaviour may explain such results. Thus, the importance of the role of a deep-rooted knowledge in affecting health-related intentions is emphasised.

3.2 Original TPB or extended TPB model

Of the 48 studies applying the TPB model, 4 described a qualitative research and 44 presented a quantitative research approach. Of the latter, 43 were observational studies characterised by a cross-sectional (n=30) or a prospective study design (n=13), for which the study duration ranged from one week to eight years. The remaining one was an experimental study with a follow up of three months. The target population was mainly represented by young adults and university students followed by adult workers, and households composed of parents having adult children, or couples without children.

3.2.1 Cross-sectional quantitative studies targeting health dimension of diet sustainability

Within the quantitative cross-sectional studies assessing intention to eat healthy (n=10), the explained intention variance ranged from 32% (Øygard & Rise, 1996) to 77% (Sumodhee & Payne, 2016), respectively in Oslovian young adults and UK mothers. Attitude represented the most relevant predictive construct both in Oslovian sample and in UK mothers. A narrower range of explained variance referred to intention was observed when an extended TPB model was used. The variance reached a minimum of 45% in adults living in UK recruited from general population (Povey et al., 2007)[1] whereas it reached a maximum of 76% in US adults at risk for diabetes (Blue, 2007). To increase the predictive power of the model and to assess the impact of two further measures of social influence, descriptive norms and perceived social support were added as both additional and moderator variables for the UK sample (Povey et al., 2007). The most significant predictors of intention were attitude followed by PBC, whilst perceived social support acted as moderator. In the other study, the intention to eat healthily was not significantly influenced by the additional

[1] The researchers applied a prospective study design, however, the healthy eating intention was cross-sectionally assessed.

construct, represented by perceived risk for diabetes (Blue, 2007). A relatively higher explained variance in the intention to healthy eating was reported also by Bebetsos and colleagues (2002). In this case, role identity and attitude strength towards healthy eating were added to the model applied to university students in Greece. However, only PBC and role identity positively impacted the students' behavioural intention (Bebetsos et al., 2002). In a cross-sectional study applying eating behaviour instead of intention as dependent variable, the TPB model provided extremely low explained variance percentages (3-8%) (Chevance et al., 2017). The multiple regression analysis was conducted independently for the subjects recruited from the general population and for obese adults, adding implicit attitudes to TPB variables. In the whole sample, intention significantly predicted behaviour recorded with a self-administered food questionnaire (Chevance et al., 2017). A cross-sectional study applied to dieting intention used self-identity, physical self-concept, and social physique anxiety as independent constructs, showing that all the constructs were significant predictors of intention, with the exception of subjective norms (Hagger & Chatzisarantis, 2006).

Within the health sustainability dimension of the diet, the quantitative cross-sectional studies dealing with more defined behavioural intention and/or behaviour than "healthy eating" presented heterogeneous results. A TPB model was applied to predict the intention to avoid sugared snacks between meals in Tanzanian students (Masalu & Åstrøm, 2003) and to predict the intention to make dietary change and reduce fat intake in adults living in the UK (Paisley et al., 1995). In the former, the explained variance reached 25%, indicating subjective norms followed by attitudes as the significant predictive constructs. In the latter, the explained variance differed on the basis of the specified dietary change, ranging from 23% in correspondence to the increase of fruit and vegetable intake to 61% for fat intake reduction. Attitude and subjective norms were also significant predictors for each dietary change considered. Four papers applying extended TPB models evaluated the intention to follow a restrictive (or specific) dietary pattern (Goodwin and Mullan, 2009; Nguyen et al., 1996; Shukri et al., 2016; Ajzen and Sheikh, 2013). The highest explained variance was obtained by Shukri and colleagues (2016) who predicted the intention to eat a low-fat diet in the following week. The relative explained variance was 63%, with several independent variables acting as positive significant predictors: attitude, self-identity, injunctive and descriptive norms, gender, and past behaviour. Conversely, not only job demands, but also the interaction of injunctive norms and work interference with family acted as negative significant predictors (Shukri, et al., 2016). The same intention, but referred to a broader time extension (4 months instead of next week) was evaluated by Nguyen and colleagues (1996) who obtained a lower explained variance (51%), equal to that reported by Goodwin and Mullan (2009), who predicted the intention of university students to perform behaviours, such as shopping, recommending, cooking/eating, related to the glycaemic index of food. However, when the intention was restricted to cooking and eating meals with a low glycaemic index, the explained variance lowered to 30% (Goodwin & Mullan, 2009). Direct and indirect determinants of intention in adults living in Quebec were included in the multiple regression analysis. However, TPB core constructs, perceived advantages of performing the behaviour, as well as the perceived power of control factor significantly increased the explained variance (Nguyen et al., 1996). The supplementary variables considered for the students were

glycaemic index knowledge and past behaviour. However, only past behaviour was a significant predictor together with attitude and subjective norms when the predicted behavioural intention referred to shopping, recommending, cooking/eating all combined, while only attitude and subjective norms were significant predictors when the behavioural intention was limited to cooking/eating behaviour (Goodwin & Mullan, 2009). As already described for less defined eating behaviour, when the regression analysis was made on behaviour instead of intention, a lower explained variance was obtained, as reported in a study referred to saturated fat intake (10%) that was significantly predicted by PBC and intention, whom effect was moderated by habit strength (de Bruijn et al., 2008). Different results were instead found by Mullan and Xavier (2013) who obtained a higher explained variance for behaviour compared to intention (27% vs 19%).

3.2.2 Prospective quantitative studies targeting health dimension of diet sustainability

Within the 14 reviewed quantitative prospective studies applying TPB, 6 referred explicitly to (healthy) eating (Armitage et al., 1999; Bassett-Gunter et al., 2013; Brouwer and Mosack, 2015; (Conner et al., 2003; Kvaavik et al., 2005; Povey et al., 2007), while 2 dealt with dieting intention and behaviour (Hagger et al., 2007; Hagger et al., 2006). With regard to dieting, the applied models explained 67% (Hagger et al., 2006) and 56% (Hagger et al., 2006) of the intention, with relatively high variability in explained behaviour (66% and 32%, respectively). In both studies, attitude followed by subjective norms and PBC significantly predicted intention, which was the unique significant predictor of self-reported dieting behaviour, as assessed through two items referring to the previous 2 (Hagger et al., 2007) or 4 weeks (Hagger et al., 2006), after participants completed the initial study measures. With regard to the healthy eating, the study duration differed significantly in the 6 reviewed studies, ranging from less than 1 week (Brouwer & Mosack, 2015) to 8 years (Kvaavik et al., 2005). The highest explained variance in intention and behaviour was observed by Conner and colleagues (2003) who reported the results separating the sample in subjects with higher and lower ambivalence with regard to the attitude about healthy eating. For the subjects who reported lower ambivalence, the model explained higher intention (87%) and behaviour (81%) compared to the counterpart (72% and 61%, respectively). Attitude, subjective norms and PBC significantly predicted intention in both groups, while the behaviour was significantly influenced by PBC and intention in subjects with mixed feelings and by PBC and attitude in people with more defined feelings.

Splitting the recruited subjects by gender, divergent results were obtained indicating lower explained variance in men, when compared to women in relation to various eating behaviours, with exception of added sugar intake (Kvaavik et al., 2005), and higher explained variance in healthy eating intention, fruit and vegetable consumption, as well as fat intake in men compared to women (54% vs 41%; 19% vs 17%; 6% vs 14%, respectively) (Bassett-Gunter et al., 2013). In the former study FFQs were applied to assess dietary intake at each time points, while a 3-day food diary was used to record behaviour in the latter.

Overall, when the hierarchical multiple regression analysis was applied in prospective studies using (healthy) eating behaviour instead of intention as final dependent variable, the explained variance reached lower percentages, as shown by Povey and colleagues (2007) (15%), Brouwer and Mosack (2015) (33%) and by Armitage and colleagues (1999) (30% and 39%, respectively in positive and negative induced mood). In

the first study, only intention and PBC were significant predictors of behaviour, which was evaluated through a FFQ (Povey et al., 2007). In the remaining two studies, a prospective assessment of dietary behaviour was made and an extended TPB model was selected, including healthy eater identity (Brouwer and Mosack, 2015) and self-identity (Armitage et al., 1999), as additional constructs. In the former, dietary behaviour was accurately evaluated using a combination of a FFQ and a 4-day food diary, while just a 3-item questionnaire was used in the latter. Healthy eater identity and PBC were significant predictors of intention, with healthy eater identity able to explain an additional 29% and 6% of intention (from 31% to 59%) and overall healthy eating behaviour variance (from 28% to 33%), respectively, compared to those explained by the TPB core constructs (Brouwer and Mosack, 2015). On the contrary, the additional construct used by Armitage and colleagues significantly affected intention in positive and negative induced mood, but not behaviour (Armitage et al., 1999).

The quantitative longitudinal studies considering more specified intentions and behaviours within the healthy diet dimension range from the adherence to a low-fat diet in the previous 3 months (Armitage and Conner, 1999; Conner et al., 2000) to avoidance of sugared snacks (i.e. sweets and cakes) and drinks (i.e. soda) in the previous four weeks (Masalu & Åstrøm, 2001). The explained variance in self-perceived behaviour referred to low-fat diet varied from 59% (Conner et al., 2000) to 46% (Armitage and Conner, 1999). Intention and past behaviour had a significant independent association with self-reported behaviour in relation to eating a low fat diet (Conner et al., 2000). Moreover, temporal stability strengthened the influence of intention and PBC on behaviour, therefore acting as moderator (Conner et al., 2000). In the study of Armitage and Conner, the variance of self-reported behaviour explained by the TPB model slightly increased over the time (t1: 46%, t2: 48%), suggesting that measuring behaviour longitudinally is comparable to measuring it simultaneously with the other TPB constructs (Armitage and Conner, 1999). Similarly, the longitudinal prediction of behaviour using TPB variables assessed previously, provided similar proportions of variance in behaviour (39%). However, a great difference can be observed comparing the predicted explained variance in self-perceived behaviour with that obtained for eating behaviour assessed through a FFQ (t1: 7%, t2: 11%; t1 to t2: 10%) (Armitage and Conner, 1999). The prediction of fat intake in combination with fruit and vegetable consumption was prospectively assessed in 36 couples without children in one study (Bassett-Gunter et al., 2015). In women, the fruit and vegetable consumption after 6 months was significantly predicted by their consumption at baseline, while, in men, after controlling for baseline fat consumption, time-related control beliefs were independently and negatively associated with 6-month fat consumption. No association was instead found between behavioural beliefs and dietary behaviours, suggesting that interventions addressed to affective and instrumental beliefs might have a limited impact on eating behaviour in healthy subjects than targeting control beliefs (Bassett-Gunter et al, 2015). The model applied by Masalu and Åstrøm (2001) in relation to avoiding sugared snacks and drinks intake in Tanzanian students explained a relatively low level of self-reported behaviour variance (20%), with past behaviour, gender, intention and PBC as positive significant predictors.

3.2.3 Experimental studies targeting health dimension of diet sustainability

One quasi-experimental study applying an extended TPB model investigated the effect of an intervention to increase calcium and vitamin D intake in first-generation Chinese-American women (Lv & Brown, 2011). Compared to the control group, the experimental one reached significantly higher intake of the macronutrients of interest after attending six weekly interactive lessons as well as at the follow up, showing a time and group effect. Conversely, normative beliefs and motivation to comply obtained higher scores only at the post-test, while behavioural beliefs, outcome evaluation, barriers, skills, self-efficacy, intention, and knowledge, significantly differed between groups at each time point, including baseline. At follow up, skills and outcome evaluation explained 59% of the intention to consume calcium rich-foods, while skills and behaviour were significant predictors of behaviour explaining 37% of calcium and 28% of vitamin D intake (Lv & Brown, 2011).

3.2.4 Cross-sectional quantitative studies targeting health and environmental dimension of diet sustainability

One study applying the original TPB model can be listed in this category (de Gavelle et al., 2019). The authors investigated participants' eating behaviour in a representative sample of French adults in terms of amount and frequency of all the food groups and found significant differences in protein intake between omnivores, vegetarians, flexitarians and pro-flexitarians, excepting for the comparison between vegetarians and flexitarians. The meat intake (g/day) and the intention to reduce meat consumption was predicted through structural equation modelling (SEM) technique which provided an explained variance of 51% and 15%, respectively for intention and behaviour. All the TPB variables significantly predicted intention, with attitude being the most impacting. Conversely, intention and PBC explained meat intake as negative predictors (de Gavelle et al., 2019).

3.2.5 Cross-sectional quantitative studies targeting environmental, socio-economic, or food quality sustainability dimension

Considering the quantitative cross-sectional studies addressed to diet sustainability dimensions other than health, 8 papers can be listed (Bhatti et al., 2019; Kim & Hall, 2019; Memon et al., 2019; Mondéjar-Jiménez et al., 2016; Onwezen et al., 2014; von Meyer-Höfer et al., 2015; Lin, 2013; Visschers et al, 2016). Among them, a model of pro-environmental behaviour in diet was studied in a sample of adults living in Taiwan, showing a significant positive influence of attitude and PBC on intention (Lin, 2013). The study included the reduction of meat consumption over the previous month, the purchase of locally produced fruit, and the in home-storage of refrigerated foods beyond the expiry date. However, pro-environmental behaviours were not significantly affected by intention and PBC, meaning that although the subjects were aware of climate change and intended to change their lifestyle, they hardly linked dietary behaviour to climate change. For food quality dimension, the intention to consume and the intake of organic products were evaluated in two publications (von Meyer-Höfer et al., 2015; Onwezen et al., 2014). The variance explained by the extended TPB model decreased moving from intention to behaviour. This happened for both German (56% to 53%) and Chilean (32% to 17%) subjects (von Meyer-Höfer et al., 2015), as well as

for Dutch people (59% to 48%) (Onwezen et al., 2014). The additionally used TPB constructs were information, convenience, egoistic and altruistic motives, price and scepticism both acting as barriers towards the behaviour. Of these, scepticism negatively influenced both intention and behaviour, which was also negatively affected by price in the German sample. On the other hand, information and price significantly and negatively impacted behaviour in Chile (von Meyer-Höfer et al., 2015). In the Dutch study the feelings of guilt and pride were added as further constructs to the model, acting both as independent and dependent variables. Of these, only guilt significantly affected intention, together with attitude, injunctive and descriptive norm (Onwezen et al., 2014). Memon and colleagues (2019) addressed the socio-economic dimension of diet sustainability by investigating the intention to consume local food in international students in Malaysia. By applying the original TPB model, 39% of intention was explained and all the intention antecedents were found as significant predictors, with subjective norms showing the highest impact.

Four quantitative cross-sectional studies dealt with food waste (Bhatti et al., 2019; Kim & Hall, 2019; Mondéjar-Jiménez et al., 2016; Visschers et al., 2016). Overall, with one exception (Mondéjar-Jiménez et al., 2016), the explained variance in intention to avoid food waste was higher than that reported for behaviour, for which explained variance reached relatively small percentages: 23% and 37% (Mondéjar-Jiménez et al., 2016), 38 and 33%, (Visschers et al., 2016), 5 and 4% (Bhatti et al., 2019), respectively for intention and behaviour. Extended TPB models were applied and a list of variables was considered. Perceived health risks were found to have a negative impact on intention, suggesting that who perceived higher risks in consuming leftovers had a lower intention to avoid food waste (Visschers et al., 2016). On the contrary, the intention to avoid food waste was positively affected by personal norms, PBC, use of bio waste container (Visschers et al., 2016), injunctive norms and attitude (Bhatti et al., 2019), the latter declined as personal and financial (Visschers et al., 2016). Being female, younger, having children and having more than two adults at home resulted in more food waste compared to their counterparts. On the other hand, food waste behaviour was negatively impacted by financial attitude, PBC, personal norms (Visschers et al., 2016), and intention to avoid food waste (Visschers et al., 2016; Bhatti et al., 2019). In the study proposed by Mondéjar-Jiménez and colleagues (2016), concerns about food waste, moral attitude and PBC significantly predicted the intention of reducing the amount of food waste. Subjective norms followed by intention and PBC were instead the most significant predictors of a correct behaviour towards food waste. However, some environmental factors during shopping (e.g., special offers, appealing packaging, product layout) were able to contrast positive food waste behaviour (Mondéjar-Jiménez et al., 2016). The remaining study (Kim and Hall, 2019) addressed to Korean diners revealed that attitude, subjective norm, PBC, climate change awareness, climate change mitigation pursuing actions and consumers' anticipated emotions of pride and guilt significantly predicted the intention to reduce food waste. Furthermore, different results were found by dividing the whole sample in low and high spending diners: the impact of PBC on intention was higher in the high spender group, while climate change awareness and mitigation pursuing actions, anticipated guilt and attitude had higher effect in the low spenders.

3.2.6 Prospective quantitative studies targeting environmental, socio-economic, or food quality sustainability dimension

The remaining longitudinal quantitative study addressed the consumption of fair trade products by a sample of Dutch adults (Onwezen et al., 2014). All the constructs applied in the model significantly predicted intention, including anticipated pride and anticipated guilt, while just intention and PBC predicted fair trade consumption. When comparing the explained variance of intention to behaviour, a relevant decrease was obtained (from 56% to 9%) using a FFQ to evaluate the consumption frequency and self-estimated intake of fair trade products (Onwezen et al., 2014).

3.2.7 Qualitative studies

Among the 4 cross-sectional qualitative research papers applying TPB, the target population was heterogeneous encompassing university students living in Naples (Italy) (La Barbera et al., 2016) and in Guadalajara (Mexico) (Sánchez et al., 2019), male truck drivers (Vayro & Hamilton, 2016) and "locavores" (Thomas & Mcintosh, 2013). Different topics were addressed, covering diet health, environmental and qualitative dimension. Exploring beliefs and healthy eating of university students in Mexico, participants believed that healthy eating is expensive and time consuming (behavioural beliefs), that the help of their mother in food preparation, as well as living with their family would help in adopting a healthy diet (control beliefs). However, they did not perceive social pressure to eat healthier (normative beliefs) (Sánchez et al., 2019). Truck drivers were involved in a belief elicitation study in the context of fruit and vegetable consumption and discretionary choice reduction. In relation to fruit and vegetable intake, the elicited normative beliefs were all positively correlated to intention and behaviour, contrarily to control beliefs which showed only negative correlations, while for behavioural belief, related to both fruit and vegetables intake and discretionary choice reduction, opposite associations were found (Vayro & Hamilton, 2016). With regard to food waste, the most frequent positive expectations cited by the interviewed respondents were saving money, followed by lowering the environmental pollution due to the lower amount of food waste disposal (La Barbera et al., 2016). On the other hand, no disadvantages were expected from the food waste reduction by most of the students. Family (households, parents) followed by friends were most significant referents that would approve the behaviour. Reducing food purchase and servings were the most cited control factors and strategies to be applied to counteract food waste (La Barbera et al., 2016). In the remaining publication (Thomas & Mcintosh, 2013) local food consumption was associated to nutritional, organoleptic, environmental and social advantages (behavioural beliefs), while family and peers were identified as important references (normative beliefs) able to affect the behaviour. Accessibility and cost were considered able to prevent the adoption of a locally sourced diet. Moreover, trust and moral obligation played a key role in promoting of local food in contrast to global food.

3.3 SCT model

Among the 5 scientific contributions applying only SCT model on dietary behaviour, 2 used a quantitative research approach (Swindle et al., 2018; Byrd-Bredbenner et al., 2011), 2 were characterised by

a qualitative study design (McGee et al., 2008; Tami et al., 2012), and 1 applied both quantitative and qualitative methods (Strong et al., 2008). The reviewed qualitative studies applying SCT were all related to the nutritional dimension involving healthy eating and dietary change behaviour.

3.3.1 Quantitative studies

Swindle and colleagues (2018) predicted 8% of variance in heathy food intake in a sample of early childhood educators, and childhood healthy food intake was found as the only one significant predictor among the applied SCT variables, whereas childhood food insecurity acted as a marginal predictor. BMI, SCT concepts, energy and nutrient intake of American mothers having primary responsibility in household food related activities were assessed by Byrd-Bredbenner and colleagues (Byrd-Bredbenner et al., 2011). The lowest scores in healthy eating self-efficacy were associated with significantly higher intake of energy, total fat, and cholesterol. Moreover, lower fruit and vegetable consumption, dietary fibre and micronutrient intake were correlated with the lowest scores in healthy eating, self-efficacy, enjoys food-related activities and food label use, and negatively associated with the TV use during dinner. The regression made on diet and health outcome expectations showed food label use reaching statistical significance as predictor (Byrd-Bredbenner et al., 2011).

3.3.2 Qualitative studies

From the focus groups conducted with lower Mississippi Delta residents (McGee et al., 2008), several personal and external factors were found to influence perceptions towards healthful food consumption. Health disorders and family members (especially children), friends, and physician were seen as strong motivators capable of influencing changes in dietary patterns. Specific mealtimes (i.e. dinner), weekend and holidays were considered occasions to prepare balanced meals, in contrast to breakfast due to limited time availability. Poor nutrition knowledge and skills related to meal preparation and planning as well as portion control emerged as personal barriers to behavioural change. Conversely, food culture and nutrition education were considered relevant factors influencing dietary change (McGee et al., 2008). Tami and colleagues (2012) found that unhealthy eating behaviours of Arab mothers living in Texas were driven by the willingness to satisfy children's preference or by the lack of accessibility to traditional food products, limited availability, affordability, and quality of fresh products. After settling in USA, Arab mothers progressively westernised their eating habits thereby reducing the consumption of traditional products (e.g., lamb meat, legumes) and simultaneously increasing the intake of fast food, sweet products and animal based-food, which were more affordable than in Arabic countries (Tami et al, 2012). Contrarily to McGee and colleagues' report, some participants stated preferring to eat at restaurants instead of cooking at home during the weekend. A commonality is instead represented by food culture that was considered a driver towards healthy eating due to the high amount of fruit and vegetables in the traditional Arabic recipes, in contrast to the western American food pattern (Tami et al., 2012).

3.3.3 Studies combining qualitative and quantitative study design

A mixed methodology was applied in a study (Strong et al., 2008) targeting college students whose dietary patterns were overall in accordance with the recommendations, even if characterised by a low amount of fruit and vegetables and whole grain. Social support and habits were associated with health-related behaviours that worse during the high school period, contributing to body weight increment. Inadequate self-regulatory skills, such as limited ability in planning and self-monitoring, were suggested as key limiting factors, also taking into account the fact that for those students healthy eating, as well as physical activity, were not considered relevant priorities (Strong et al., 2008).

3.4 Mixed models

A total of 12 studies were performed applying more than one theoretical model. Among them, 8 selected one theory between TRA, TPB and SCT combined with one of the following: health belief model (HBM), trans-theoretical model (TTM), self-regulation theory (SRT), protection motivation theory (PMT) or social determination theory (SDT). The remaining four studies used three or more theoretical frameworks (Liou and Bauer, 2007; Ruhl et al., 2016; Russel et al, 2017; Peng, 2009), using HBM, comprehensive model of environmental behaviour, social-ecological models or prototype/willingness, and reasoned reactive models.

3.4.1 Quantitative studies

Chinese-American living in New York were assessed in two publications reported by Liou and colleagues (2011, 2014) who independently investigated intention to engage in obesity risk reduction behaviour and the adoption of such behaviour. Dividing the subjects according to the degree of acculturation, the highest explained intention variance was obtained in Asian-identified individuals (41%), while for higher acculturated subjects the model showed the lowest explained variance (7%). Different significant predictors were found in each subgroups: only attitude in the western-identified group; subjective norm and self-efficacy in the bicultural group; perceived benefits, PBC and self-efficacy in Asian-identified subjects (Liou et al., 2014). The psychological variables explained 40% of overall risk reduction behaviour encompassing 19 single behaviours divided into 5 domains (Liou et al., 2011). However, when, for the whole sample, the regression analysis was applied on the eating and food context, the explained variance decreased to 20% and 31%, respectively. Discriminating for gender, age, BMI categories, and acculturation subgroups, the highest explained variance was obtained for obese people (53%) for which intention was the only significant predictor. Several variables significantly affected intention to eat healthily among dieters and non–dieters college students (Ruhl et al, 2016). Attitude, nutrition knowledge and willingness to eat healthy food in contexts that may favour unhealthy eating resulted the significant predictors associated with dieters, while just attitude significantly predicted intention in non-dieters. No variable reached statistical significance as predictor of behaviour in non-dieters, while willingness and intention did for dieters. The model used to evaluate intention to follow a plant-based diet in psychology students explained 61% of the variance (Wyker & Davison, 2010). With a few exceptions, TPB constructs statistically differed across the stage of changes

(i.e. pre-contemplation, contemplation and preparation), with an increase of attitude and intention in each subsequent stage (Wyker & Davison, 2010). The last quantitative studies reporting a combination of theoretical frameworks applied a randomised controlled experiment in which a computer game was used to promote healthy eating in young adults (Peng, 2009). Post-test nutrition knowledge specified in the game and the intention to eat a healthy diet resulted significantly higher in the intervention group compared to the control group. At one month of the follow-up, the food pyramid knowledge decreased in both the groups, while long term effect of the game was observed on self-efficacy. Statistical analysis did not show univocal finding on perceived benefits and barriers comparing all time points, thus no long term effect of the game on these outcomes was confirmed.

Food waste reduction intention and food waste behaviour were assessed in an observational prospective investigation in UK adults (Russell et al., 2017). The longitudinal assessment of food waste representing the final dependent variable obtained higher explained variance compared to the intention (46% vs 29%) which was significantly predicted by PBC, subjective norm, and negative emotions. Habitual (past) behaviour and negative emotions significantly influenced behaviour which was also directly and negatively affected by intention. These paths indicated that experiencing more negative emotions about food waste was associated with a stronger intention to reduce food waste, but also with higher food waste behaviour (Russell et al., 2017). Moreover, these results demonstrate the relevance of non-cognitive factors (habits) in understanding and predicting behaviour.

3.4.2 Qualitative studies

Six qualitative studies combined mix models targeting (young) adults in various geographical areas from Europe to North and South America. Major themes related to healthy eating elicited by Alexander and colleagues (2018) included motivations and strategies for eating well, as well as learning how to do it. Self-awareness, personal motivations, and social context emerged as relevant determinants capable of fostering self-determination to eating well (Alexander et al, 2018). In a study carried out to understand the determinants of healthy dietary behaviours in Mexican adults, attitude was found to poorly explain self-reported behaviour (Carrete & Arroyo, 2014). The findings suggested that a low level of self-efficacy and high costs preclude behavioural change towards healthy eating. The intention of adopting a healthy diet was negatively influenced by low vulnerability and severity levels which characterised young adults who selected food mainly based on sensorial attributes (i.e. texture, flavour, colour, smell and appearance) rather than the nutritional value of the products (Carrete & Arroyo, 2014). A convenience sample of American rural women was recruited to assess their perception on how to prevent cardiovascular diseases and investigate behavioural changes for cardiovascular health (Krummel et al, 2002). Poor awareness of personal cardiovascular risk, family preference for unhealthy food, cultural food patterns, sensorial aspects (i.e. taste), cost and lack of support from family or friends were major barriers to a heart-healthy diet. On the other hand, initiating motivators (e.g., emotional arousal) to start dietary change and sustaining motivators (e.g., improving skills and learning) in maintaining dietary modifications were essential facilitators for behavioural change. Self-efficacy for behaviour change varied widely in the sampled women and no substantial age

difference was observed (Krummel et al, 2002). In-depth interviewed Chinese-American young adults in New York showed their beliefs and attitude concerning obesity risk indicating dietary habits and sedentary lifestyles as the main leading factors towards weight gain (Liou & Bauer, 2007). Extrinsic factors, such as advertisements generated by media, cheap and convenience fast food products were considered as relevant drivers. In addition, higher acculturation (i.e. lifestyle westernisation) was associated to a decreased adherence to Chinese traditional food consumption that was considered healthier. Obesity was generally not perceived as an important problem for Chinese ethnicity, even if the perceived susceptibility to obesity was encountered in 60% of the respondents who mentioned poor diet, genetic factors and lack of exercise as risk factors. Strategies mentioned to prevent obesity were the reduction of portion sizes and fast food consumption, eating breakfast, and eating at home (Liou & Bauer, 2007). With regard to healthy eating, similarly as reported in other studies (Krummel et al, 2002; Povey et al., 2007), a qualitative investigation on adults of different nationalities (i.e. Moroccan, Dutch, Turkish) and living in the Netherlands provided that social support given by family, partners and children is a key factor in favouring healthy eating (Romeike et al., 2016). Beliefs and barriers towards healthy eating were mostly related to knowledge, attitude, social influences and PBC in all ethnic groups. Religion and culture were however discussed as influencers by Turkish and Moroccan participants, and not by Dutch people (Romeike et al., 2016). Beliefs related to healthy eating were also reported by White and colleagues (2010) in Hispanic women living in the USA. Disease prevention and help in reducing weight and prolonging life were mentioned among the perceived benefits of eating healthy foods. However, even if most of the respondents stated that it was easy to eat healthy food and most of them said it was not more expensive, less than half declared to eat it on a regular basis. Respondents cited lack of time and of family support (e.g., lack of a babysitter), need for transportation, and poor cooking skills as barriers (White et al., 2010). Manios and colleagues (2007) reported the effect of a nutrition education program targeting post-menopausal women. The intervention aimed at improving nutritional knowledge, self-efficacy towards healthy eating and osteoporosis awareness led to higher calcium and vitamin D intake, and lower fat intake in the intervention group compared to the counterpart. Qualitative assessment (HEI scores) provided instead alternative outcomes: milk and fat HEI scores improved in the intervention group compared to the control group, while the total scores and the grains intake score increased in both the groups, even though to a higher extend in the control group (Manios et al., 2007).

Table 6. Main strengths and limitations found in the reviewed studies divided by the applied theoretical model and sustainability dimension.

Sustainability dimension	TRA/TPB	SCT	MIXED theoretical approach
Health	<u>Quantitative study design (n=36)</u> • Great variability in explained BI (R^2: 19-87) and B (R^2: 3-81) variance. • Overall, more objective behavioural measures (FFQ and FR) are linked to lower R^2 values compared to self-perceived behaviour. • Overall, the prospective study design is associated with higher R^2 performance compared to cross-sectional studies. • In cross-sectional studies causal prospective prediction of dependent variables is precluded. • Convenience samples limit results generalisability. • In longitudinal studies there is evidence of predictive validity of the TPB over time. • Self-reporting bias in behaviour assessment can be overcome by applying multiple data collection methods. <u>Qualitative study design (n=2)</u> • TPB belief-based framework effectively provides insight into key behavioural, normative and control beliefs affecting food choices. • Small sample size may fail to fully represent the target population. • Self-reported outcome measures are potentially less reliable compared to objective evaluations.	<u>Quantitative study design (n=2)</u> • Limited explained variance found in behaviour (R^2: 8), self-efficacy (R^2: 26) and outcome expectations (R^2: 8). • Sampling methods (e.g., convenience samples) limit result generalisability. • Self-reported anthropometric measures may be underestimated. <u>Qualitative study design (n=2)</u> • Recruitment of convenience samples. • Considering culture and tradition peculiarities of the target population, developing supportive networks and demonstrating behavioural outcomes are recommended strategies to develop interventions addressed to change behaviour. <u>Qualitative and quantitative study design (n=1)</u> • Social and environmental support is recommended to foster the desired dietary behaviour.	<u>Quantitative study design (n=5)</u> • High variability in explained BI variance (R^2: 7-61) and medium explained variance in B (R^2: 20-31). • Convenience samples limit results generalisability. • Longitudinal studies recommended to assess outcome measures stability and causal relationships. • If any, anthropometric measures are self-reported. • Psychosocial factors and acculturation need to be considered to influence health behaviours in immigrant populations. • Combining variables from multiple theoretical models has been recommended to increase their predictive power. • Salient beliefs assessment is recommended when TPB is applied. • Socio-cognitive factors and personal readiness assessment are functional to the development of stage-tailored communication. <u>Qualitative study design (n=6)</u> • Culture, degree of acculturation, taste, cost family/social support drive positively or negatively food choices. • Sample size recruitment limit results generalisability. • Higher focus on low socio-demographic segments is recommended. • Behavioural change towards a healthy diet could benefit from social marketing programs both in high income countries and emerging economies. • With one exception, no anthropometric data have been collected. • Combining qualitative and quantitative research is recommended. • Potential misinterpretation of interviews by researchers. • An ecological approach involving taxation policies, food laws, and regulations is suggested. <u>Qualitative and quantitative study design (n=1)</u> • The methodology to assess diet quality needs to be carefully evaluated considering the geographical context and anthropometric variables.

661 **Table 6.** *Cont.*

Sustainability dimension	TRA/TPB	SCT	MIXED theoretical approach
Health + Environmental	<u>Quantitative study design (n=1)</u> • Representative sample at national level. • Use of non-validated tools to assess dietary intake prevents the assessment of nutrient intake or adequacies. • Potentially underestimated declared anthropometric data and unhealthy food intake.	-	-
Food quality	<u>Quantitative study design (n=2)</u> • Medium-high variance in explained BI (R^2: 32; 56) and B (R^2: 17-53). • TPB-based model adequately explains consumer attitude and behaviour in the organic market. • Non-representative samples limit results interpretation. • Low educational and income groups not evaluated. • Use of stated behaviour measures instead of actual measures. • Multiple indicators to measure attitude, intention and behaviour are recommended to improve estimates precision.	-	-
Environmental	<u>Quantitative study design (n=5)</u> • High variability in explained BI (R^2: 5-61) variance and low-medium explained variance in B (R^2: 4-33). • More detailed behavioural measures are not linked to lower R^2, however to avoid under-estimates, objective measures (e.g., direct weighting of food waste) are recommended. • Prospective study design is explicitly recommended to better predict causal relationships between behaviour and its determinants. • Developing economies (i.e., Pakistan) with younger demographic profile have been object of investigation. <u>Qualitative study design (n=1)</u> • Content analysis can show different people's approaches (e.g., rational *vs.* moral) characterised by different patterns. • Influence of contextual factors (e.g., territory) on behavioural determinants (e.g., subjective norm).	-	<u>Quantitative study design (n=1)</u> • Higher explained variance in B (R^2: 46) compared to BI (R^2: 29). • Prospective evaluation of behavioural outcomes prevents the influence of common method variance on results. • BI is not necessarily a proxy of behaviour as different relationships between them and behavioural antecedents can be found. • The efficacy of short-term and long-term behavioural changes approaches should be tested in the future. • A more adequate understanding of psychological antecedents is more likely to consider both cognitive and non-cognitive (e.g., habits and emotions) factors. • Lager sample size and recruitment are recommended to improve the statistical analysis (e.g., to apply structural models instead of path models) and to generalise findings to the general population. • Observational measures should be preferred compared to self-reported behaviour. • "Positive" campaigns may be more successful than the "negative" ones.

Table 6. *Cont.*

Sustainability dimension	TRA/TPB	SCT	MIXED theoretical approach
Socio-economic	<u>Quantitative study design (n=2)</u> • Both cross-sectional and prospective study designs have been applied. • Medium and low explained variance respectively in BI (R^2: 39) and B (R^2: 9). • Influence of contextual factors (e.g., being in a host country) on behavioural determinants (e.g., subjective norm). • Limits in the generalisability of the findings due to sampling techniques. • <u>Qualitative study design (n: 1)</u> • TPB-model effectively provides insight into behavioural, normative and control beliefs in the target population. • Lack of national representativeness at national level of the studied sample. • Formative research can benefit from the focus groups technique due to the triggered discussion among participants. • Data saturation should be achieved in case of small sample size.		

Note: Data are reported distinguishing quantitative from qualitative research approach. References grouped for theoretical framework and methodology approach can be found in Supplementary File 1. B: behaviour; BI: behavioural intention; SCT: Social Cognitive Theory; TPB: Theory of Planned behaviour; TRA: theory of Reasoned Action.

Discussion and conclusions

Of the 67 reviewed papers, 56 addressed to a differentially connoted health dimension therefore accounting as the most studied dimension within sustainable diet research, whereas environmental and socio-economical dimensions have been poorly investigated when TRA, (extended) TPB and/or (extended) SCT have been used. Only one of the reviewed studies targeted simultaneously more than one sustainability dimension, therefore being a limit to scientific evidence due to the wide and complex challenges around sustainable diets (Burlingame & Dernini, 2012).

A wide range of explained variance of intention (7-87%) and/or behaviour (3-81%) was observed comparing the studies applying a quantitative methodology approach and targeting dietary behaviour from the nutritional point of view, across different applied models and study designs. Thus, if accurately developed and adapted, social-psychological models have the potential of being useful when applied to the eating context. With a few exceptions, the explained variance of behaviour was relatively lower if compared to that computed for intention, as well as when behaviour was evaluated more objectively and prospectively (e.g., using food diaries and/or FFQs). On the one hand, this can be considered a limitation of social cognitive models that might fail to fully understand and predict dietary patterns in longitudinal studies due to the multitude of factors and discrete behaviours playing a role in determining them. On the other, a reliable assessment of behaviour is crucial in avoiding misconception in the obtained results. Albeit potentially less effective if used in social cognition models, the selection of prospective study designs and validated and accurate dietary assessment tools can be considered a valuable approach to obtain more reliable predicting analyses on behaviour. The current review confirms previous observations asserting that the intention-behaviour association is higher when behaviour is recorded through self-report measures compared to objective measures (Armitage & Conner, 2001; McEachan, Conner, Taylor, & Lawton, 2011). Accordingly, the associations between TPB variables and behaviour may be overestimated by the fact that self-perceived food consumption is likely to be biased (McDermott et al., 2015). For this reason, it could be interesting combining subjective and objective dietary assessment tools to identify potential gaps between the self-perception of behaviour and its actual performance. To increase the accuracy of the results, socio-demographic factors and anthropometric variables, should be assessed and applied as moderators in the multiple step regression analysis or structural equation models. Likewise, the assessment of other non-cognitive factors, for instance degree of acculturations, habits, and emotions, might improve the understanding of behaviour. Indeed, combining multiple factors derived from multiple theoretical models to increase their predictive power (Liou et al., 2011) is one of the several recommendations that can be drawn on the basis of the collected data. The majority of the studies applied a cross-sectional study design, which is more feasible and less resource-intensive compared to longitudinal design. However, longitudinal studies are recommended to determine outcome measure stability (Conner et al., 2000). In addition, longitudinal studies can provide a prospective prediction analysing the causal relationship between dependent and independent variables, that would be otherwise precluded in cross-sectional investigations (McEachan, Conner, Taylor, & Lawton, 2011; Wyker & Davison, 2010). Moreover, potential bias in self-reported behaviour evaluations,

and risk of underestimates in anthropometric data have been reported in several reviewed studies, irrespectively to the selected theoretical model and the sustainability dimension investigated (Byrd-Bredbenner et al., 2011; Vayro and Hamilton; Liou et al., 2014; de Gavelle et al., 2019; Russel et al., 2017). To overcome these limitations and improve behaviour assessment accuracy, the use of multiple data collection methods and indicators (von Meyer-Höfer et al., 2015) could be indicated as a viable solution.

Overall, across all theoretical frameworks, attitude (including affective and moral attitude) towards the behaviour was found as the most significant predictor of intention in 13 investigations and 22 models. Of these studies, 9 referred to the health dimension (healthy diet consumption and dieting behaviour), while the remaining ones referred respectively to food quality (organic food consumption, n=1), environmental dimension (food waste reduction, n=2) and to health and environmental diet sustainability simultaneously (n=1). PBC was found as the major predictor of intention in 8 studies and 10 regression models, all involving healthy diet, except two which referred to food waste reduction and pro-environmental behaviour. With regards to the subjective norms (including personal, descriptive and injunctive), the highest relevance as intention predictor was found in 10 studies and 18 models, ranging from the health dimension (n=6 to local food intake (n=1), organic food (n=1) and fair trade (n=1) consumption, as well as pro-environmental behaviour (n=1). Therefore, interventions to change the intention to follow a sustainable diet in adults should first of all target individuals' attitude, social norms, followed by perceived barriers and facilitating factors. Role identity and past behaviour emerged as important determinants since they are able to significantly explain the intention variance when used as additional constructs in different socio-cognitive models.

Intention was identified as a significant predictor in all the studies in which behaviour was entered as the dependent variable in the multiple step regression analysis or structural equation models, with one exception (Ates, 2019). It was also the most relevant factor in 12 studies and 23 models. In some cases, subjective norms, past behaviour, self-efficacy, PBC and socio-demographic variables (e.g., gender) resulted in higher standardised regression coefficients than intention. This partially contradicts the theoretical framework, while simultaneously showing the complexity of the decision-making process which is affected by multiple intrinsic and extrinsic factors. Belonging to different dietary cultures has the potential to shift the relative relevance of behavioural determinants, similarly to other background factors, such as age, gender, living in rural or urban area, etc. For developing effective interventions promoting sustainable dietary behaviours, it is important to tailor initiatives on the target population taking into account its potential heterogeneity. As a consequence, investigating consumers' motivation, attitude, perceived control, as well as other relevant extrinsic and intrinsic variables considering its peculiarities can be considered a valuable strategy to attract educational programmes initiatives.

Qualitative investigations pointed out relevant drivers and barriers, such as culture, degree of acculturation in case of immigrant populations, taste, cost, family and social support, able of influencing dietary behaviour towards a sustainable direction. In this context, motivations and learning, rooted in an adequate nutritional knowledge, are essential determinants to drive the behavioural change. Qualitative studies stressed the need to develop a supportive environment enabling the sustainable behavioural transition

(McGee et al. 2008; Krummel et al., 2002; Tami et al, 2012). The advantages of using the qualitative research approach framed in psycho-social theories, rely on the possibility to gain relevant insights into behavioural, normative and control beliefs that a quantitative approach would not be able to provide. However, to fully exploit this approach, the sampling method and the content analysis are crucial to obtain reliable results and proper interpretations. For example, in case of small samples, data saturation should be achieved to exhaustively bring out the salient beliefs.

4 Future perspectives

The majority of the studies was conducted in convenience or small samples limiting the result generalisability for the target population. Therefore, randomisation techniques and national representative samples are suggested to inform policy makers and professionals involved in designing campaigns aimed at changing behaviours. In addition, most of the studies were carried out in higher income economies, highlighting the need of further studies targeting low- and middle-income countries. The projected increase in income in low and middle income economies will likely increase the consumption of animal sourced foods, such as meat and dairy, therefore increasing greenhouse-gas emissions, cropland use, freshwater use, and nitrogen and phosphorus application by 50–90% from 2010 to 2050 (Willett et al., 2019). Thus, more in-depth scientific evidence of the determinants capable of inducing dietary changes in these countries is essential to mitigate such environmental effects.

Raising people's awareness about the role and impact, including environmental implications, of eating behaviours at both the individual and community level, needs to be addressed in experimental studies to be effective in boosting and sustaining shifts in the desired direction. Providing tools to improve skills in planning daily activities, selecting and preparing food can be a valuable strategy to enhance the person's perceived control and ability to follow a sustainable eating behaviour characterised by a seasonal and local food consumption, as well as a limited intake of animal based-products, as described by the EAT Lancet Commission (Willett et al., 2019). To improve studies on sustainable eating behaviour future research should include different sustainability outcomes to better assess sustainable dietary behaviours.

By identifying the drivers of consumer behavioural changes, the collected results may support policy makers in providing recommendations and defining primary prevention interventions which enhance consumer awareness and engagement towards more sustainable dietary habits. Being the affordability a recurring barrier declared by the recruited samples, primary interventions may benefit from complementary harder interventions, such as incentives, to foster the consumption of healthy food through subsidies that reduce the final cost of such products to the final consumers. Future research could apply the psycho-social theories with the aim to predict consumer behaviour analysing the potential effect of the cost reduction of healthy products.

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