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Research Article

Extending the Theory of Planned Behavior for Explaining Dietary Quality: The Role of Financial Scarcity and Food Insecurity Status

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ABSTRACT

Objective: To examine whether an extended Theory of Planned Behavior (TPB) that included finance-related barriers better explained dietary quality.

Design: Cross-sectional survey.

Participants: One-thousand and thirty-three participants were included from a Dutch independent adult panel.

Main Outcome: Dietary quality.

Analysis: Five TPB models were assessed: a traditional TPB, a TPB that included direct associations between attitude and subjective norm with dietary quality, a TPB that additionally included financial scarcity or food insecurity, and a TPB that additionally included financial scarcity and food insecurity simultaneously. Structural relationships among the constructs were tested to compare the explanatory power.

Results: The traditional TPB showed poorest fit (χ^2/degrees of freedom = 11; comparative fit index = 0.75; root mean square error of approximation [95% confidence interval], 0.10 [0.091−0.12]; standardized root mean square residual = 0.049), the most extended TPB (including both financial scarcity and food insecurity) showed best fit (χ^2/degrees of freedom = 3.3; comparative fit index = 0.95; root mean square error of approximation [95% confidence interval], 0.050 [0.035−0.065]; standardized root mean square residual = 0.018). All 5 structure models explained ∼42% to 43% of the variance in intention; however, the variance in dietary quality was better explained by the extended TPB models, including food insecurity and/or financial scarcity (∼22%) compared with the traditional TBP (∼7%), indicating that these models better explained differences in dietary quality.

Conclusions and Implications: These findings highlight the importance of accounting for finance-related barriers to healthy eating like financial scarcity or food insecurity to better understand individual dietary behaviors in lower socioeconomic groups.

Key Words: Theory of Planned Behavior, financial scarcity, food insecurity, diet quality (*J Nutr Educ Behav.* 2022;54:636−646.)

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INTRODUCTION

Poor dietary behavior is a major contributor to chronic disease morbidity and mortality worldwide,[1] and dietary behavior is generally poorest among socioeconomically disadvantaged groups.[2] Determinants of unfavorable dietary behavior among these groups remain poorly understood; however, a better understanding is needed to achieve healthier dietary behavior and reduce diet-related disparities.

One of the most commonly used models for understanding health behaviors such as dietary behavior is the Theory of Planned Behavior (TPB).[3] According to the TPB, behavior is influenced by the intention to perform the behavior. This intention is influenced by the positive or negative evaluation of the behavior (ie, attitude), the perceived social pressure and expectations to perform the behavior (ie, subjective norm), and the perceived control over the

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behavior (ie, perceived behavioral control). Besides the indirect influence of perceived behavioral control through intention, it can also directly influence the behavior. A more favorable attitude, subjective norm, and perceived behavioral control toward the behavior would lead to a stronger intention to perform the behavior. This intention, in turn, influences the likelihood that the behavior is performed.[3,4]

A systematic review conducted by McEachan et al,[5] confirmed that the TPB is a suitable model for explaining intention and behavior across various health behaviors such as physical activity and sexual reproductive behavior. However, dietary behavior is complex because it is also driven by contextual factors such as perceived psychological stress.[6] Indeed, the potential of the TPB to explain dietary behavior seems to be limited.[4] This indicates that factors other than attitude, subjective norm, perceived behavioral control, and intention may play an important role in motivating dietary behavior. Socioeconomically disadvantaged groups generally have poorer dietary quality,[2] and studies that elaborate on this association show that financial resource-related matters influence the intention to eat a healthy diet and the actual eating behavior.[7,8] For example, financial stress, impaired mental health, and perceived high costs of healthy food were mentioned as barriers to healthy eating[7]

Extending the TPB by including these factors may help explain dietary behavior and differences for people of different socioeconomic positions (SEPs). Differences in dietary quality related to SEP may be partially explained by generally higher costs of healthier diets and lower healthy food availability in lower SEP neighborhoods.[2] However, other factors also constitute resource constraints and influence dietary behavior among lower SEP individuals.[9] Following the conceptual framework proposed by Laraia et al,[9] poverty indeed influences healthy food purchasing power and insecurities (including food insecurity) and biobehavioral mechanisms (including stress, sleep, and cognitive burden). Especially these insecurities trigger hormonal responses (ie, stress-, appetite-, and hunger-regulating hormones) that shape eating behavior. These factors create a scarcity mindset, which (together with a poverty-induced reduced purchasing power) adversely influences dietary behavior and diet quality.[9]

Food insecurity is a complex, multidimensional phenomenon that reflects limited or uncertain access to adequate food that meets dietary needs and food preferences for an active and healthy life.[10] For example, food insecurity may include (anxiety and worries about) not having enough (healthy) foods, (perceived) social exclusion, and the inability to acquire food in a socially acceptable way. Research shows that the impact of food insecurity on (mental) health and stress may also lead to a tendency to consume unfavorable, highly palatable foods.[9,11] Indeed, both national and international research has shown that food insecurity is associated with poorer dietary quality.[12,13]

Financial scarcity can be defined as the subjective experience of having fewer financial resources than needed.[14] Studies have shown that experienced financial scarcity can have negative psychological consequences. For example, it impedes executive functions[15] and increases depression and anxiety.[16,17] Moreover, having limited resources can lead to a self-reinforcing cycle between causes and consequences of poverty, also known as a poverty trap.[18] When resources are scarce, (potential) problems loom larger and seize attention, and because of the greater engagement in trying to solve these problems, scarcity leads to neglect of other (potential) problems and longer-term goals, including health.[19,20] Hence, experienced financial scarcity and the uncertainties and stress associated with it may impede cognitive control functions needed for healthy food choice. Beenackers et al[21] described that financial strain is associated with unhealthy behavior, partially mediated by lower self-control. This helps explain the difficulty of eating healthy when experiencing financial scarcity.

Although perceived food insecurity and financial scarcity are closely related,[22] each represents separate constructs. Financial scarcity reflects a perceived shortage of money in general and control over the financial situation, whereas food insecurity reflects perceived inadequate access to food specifically, thereby capturing psychosocial stress related to perceived inadequate access to food. As both constructs are associated with unfavorable eating behavior, extending the TPB by including food insecurity and financial scarcity may be promising for explaining dietary behavior and differences for people of different SEPs. Therefore, the current study aims to assess whether extending the TPB with barriers related to financial scarcity and food insecurity better explains dietary quality.

METHODS

Study Population and Data Collection

Data for this cross-sectional study were collected in December, 2020 through online questionnaires sent to a Dutch independent panel that operates in line with International Organization for Standardization standards.[23] We included adults living across the Netherlands, including rural and urban areas, with oversampling on a relatively lower SEP: approximately four fifths of the sample was selected to have a lower SEP. This was based on 3 combinations of their income and educational level: (1) below mode income and low educational level, (2) mode income and low educational level, or (3) below mode income and intermediate educational level. Questionnaires were available in the Dutch language. The study was reviewed by the Medical Ethics Committee of Leiden University Medical Centre and confirmed not to be subject to the Medical Research Involving Human Subjects Act.

Variables and Measurements

Dietary intake and dietary quality. Dietary intake was assessed using an adapted version of the Dutch

Healthy Diet Food Frequency Questionnaire.[24] Based on the dietary intake, adherence to the current dietary guidelines[25,26] was assessed for the following components: vegetables, fruit, legumes, unsalted nuts, fish, grain products, dairy, tea, coffee, oils and fats, sugar-containing beverages, savory snacks, and sweet snacks. Each component was assigned a score ranging from 0 to 10, with higher scores indicating better adherence to the dietary guidelines (Supplementary Table 1). All component scores were summed, resulting in a total dietary quality score with a theoretical range from 0 to 130 points.

Constructs of the TPB. Psychosocial factors related to dietary behavior were assessed on the basis of the constructs of the TPB.[3] Items were selected in a multiple-step process. First, we selected general constructs on the basis of the TPB.[3] Second, we applied the specific health behavior of interest (ie, dietary behavior) to these general constructs. We included items reflecting subjective norms regarding healthy eating in general for the construct subjective norm. We included items regarding healthy eating in general for the other constructs, and additionally included items specifically regarding fruit and vegetable consumption and snack and fast-food consumption. For each construct, multiple items were included to reflect that particular construct. Specific items per construct are presented in Supplementary Table 2.

Attitude toward healthy eating, fruit and vegetable consumption, and snacks and fast-food consumption were assessed on the basis of 24 items. Attitude was assessed using 7-point Likert scales ranging from positive to negative (eg, I think healthy eating is… good for me [1 point], bad for me [7 points]). These scores were then reversed so that higher scores indicate a more positive attitude toward the eating behavior in question.

Subjective norm regarding healthy eating was assessed on the basis of 6 items (eg, my family and/or friends think it would be good if I eat healthy/more healthy in the next 3 months) using 7-point Likert scales ranging from strongly disagree (1 point) to strongly agree (7 points) so that higher scores indicate a stronger perceived subjective norm regarding healthy eating.

Perceived behavioral control was assessed on the basis of 8 items (eg, I feel in control about eating healthy/more healthy in the next 3 months) using 7-point Likert scales ranging from strongly disagree (1 point) to strongly agree (7 points) so that higher scores indicate a stronger perceived behavioral control.

Intention to eat healthy was assessed on the basis of 5 items (eg, I intend to eat healthy/more healthy in the next 3 months) using 7-point Likert scales ranging from strongly disagree (1 point) to strongly agree (7 points) so that higher scores indicate a stronger intention to eat healthy.

Financial scarcity and food insecurity. Financial scarcity was assessed on the basis of the short version of the Psychological Inventory of Financial Scarcity, a validated scale showing good validity and reliability developed by van Dijk, van der Werf, and van Dillen.[27] The Psychological Inventory of Financial Scarcity assesses experienced financial scarcity and captures 4 aspects of this subjective experience: appraisals of insufficient financial resources and lack of control over one's financial situation, in addition to responses concerning financial rumination and worry,
and a short-term focus. The scale included 5 statements (eg, I am constantly wondering whether I have enough money) for which participants could indicate to what extent they agreed with the statements on 7-point Likert scales ranging from strongly disagree (1 point) to strongly agree (7 points) so that higher scores indicate a higher perceived experience of financial scarcity.

Food insecurity status was assessed using the 6-item US Department of Agriculture Household Food Security Survey Module. This original survey was previously translated from English to Dutch by Neter et al,[28] using the translation and back-translation technique. Affirmative responses to questions addressing food insecurity-related conditions were summed, resulting in a food insecurity score ranging from 0 to 6. The food insecurity score was dichotomized into food secure (0 affirmative responses, high food security) and food insecure (1–6 affirmative responses, marginal, low, and very low food security), according to current international recommendations to count marginal food insecurity as part of food insecurity.[29]

Sociodemographic covariates. Age, sex (male/ female), country of birth, marital status, educational level, employment status, income, smoking status, height, and weight were assessed. The body mass index (BMI) of the participants was calculated from their self-reported weight and height and classified into normal weight (BMI < 25 kg/m^2), overweight (BMI 25–30 kg/m^2), and obese (BMI ≥ 30 kg/m^2), using the World Health Organization cutoff points.[30] Country of birth was categorized into the Netherlands and others. Educational level was categorized into low (upper secondary education or lower), intermediate (postsecondary to short-cycle tertiary education), and high (bachelor degree or higher education). Income was categorized into minimum income, below mode income, and mode income or higher (mode income refers to the income that is most commonly earned in the Netherlands). Smoking status was dichotomized into a current smoker (yes/no). Employment status was dichotomized into currently employed (yes/no). Furthermore, we included the livability index[31] as a measure of the livability of the neighborhood ranging from poor[1] to outstanding.[9] This index is based on 50 indicators which can be further divided into the following underlying 6 dimensions: housing stock, public space, level of facilities, (social/ economic) population composition, life structure and social cohesion of the population, inconvenience, and safety.[31] The livability index was linked to the dataset on the basis of 4-digit postal code of the participants.

Statistical Analyses

Population characteristics for the total study population and split by food insecurity and financial scarcity status were presented using descriptive statistics. To test the differences between food secure vs food insecure participants and between participants experiencing no financial scarcity vs participants experiencing financial scarcity, independent samples *t* tests were performed for continuous variables, and χ^2 tests for independence were performed for categorical variables.

Linear regression analyses were conducted to assess associations between food insecurity, financial scarcity, attitude, subjective norm, perceived behavioral control, intention, and dietary quality. Specifically, 6 models were analyzed: (1) a model with dietary quality as outcome and food insecurity, financial scarcity, attitude toward healthy eating and fruit and vegetables, attitude toward snacks and fast food, subjective norm, perceived behavioral control, and intention as predictors; (2) a model with intention as outcome and food insecurity, financial scarcity, attitude toward healthy eating and fruit and vegetables, attitude toward snacks and fast food, subjective norm, and perceived behavioral control as predictors; (3) a model with attitude toward healthy eating and fruit and vegetables as outcome and food insecurity and financial scarcity as predictors; (4) a model with attitude toward snacks and fast food as outcome and food insecurity and financial scarcity as predictors; (5) a model with subjective norm as outcome and food insecurity and financial scarcity as predictors; and (6) a model with perceived behavioral control as outcome and food insecurity and financial scarcity as predictors. All linear regression analyses were performed both crude and adjusted for age, sex, income, educational level, employment status, marital status, country of birth, and livability index.

Exploratory factor analysis (EFA) was conducted to obtain the variable sets that best explained the underlying constructs (ie, attitude, subjective norm, perceived behavioral control, intention, and financial scarcity). Items with component loadings above 0.3 were retained. We used one-half of the dataset (n = 517) for the EFA and the other half for confirmatory factor analysis (CFA) (n = 516) (described hereafter). As described by Boateng et al,[32] a sample size of > 500 is sufficient for factor analysis. They describe a sample size of 500 as very good for factor analyses and suggest that, as a rule of thumb, the ideal ratio of respondents to items is 10:1 as, which is achieved in our study.[32]

Five TPB models were assessed: 1 traditional TPB and 4 extended TPB models (a TPB that included direct associations between attitude and dietary quality and between subjective norm and dietary quality; a TPB that additionally included financial scarcity or food insecurity; and a TPB that additionally included financial scarcity and food insecurity simultaneously) (Supplementary Figure 1). To compare the explanatory power of these models, structural relationships among the constructs were tested using structural models.

As recommended by Anderson and Gerbing,[33] a 2-step procedure with the maximum likelihood estimation method was applied. In the first step, CFA was conducted to assess the goodness-of-fit of the model and the reliability and validity of the constructs (ie, attitude, subjective norm, perceived behavioral control, intention, and financial scarcity). In the second step, the hypothesized structural relationships (ie, paths) among the latent constructs were tested using structural equation models. All models were adjusted for age, sex, income, educational level, employment status, marital status, country of birth, and livability index. Model fit was assessed using absolute, parsimonious, and incremental indices: we assessed the χ^2 to degrees of freedom (df) ratio (χ^2/df), comparative fit index (CFI), the root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR).[34] Model fit was deemed acceptable if $\chi^2/df \leq 5$; CFI ≥ 0.90; RMSE ≤ 0.10; and SRMR ≤ 0.08. Furthermore, explained variance was assessed for intention, dietary quality, and the overall model.

Confirmatory factor analysis and path analyses were conducted using Stata (version 16.1, StataCorp, 2015). All other statistical analyses were performed using SPSS (version 25.0, IBM Corp, 2012). A 2-sided $P < 0.05$ was considered statistically significant.

RESULTS

Factor Analyses for Model Constructs

The variable sets that best explained the underlying constructs (ie, attitude, subjective norm, perceived behavioral control, intention, and financial scarcity) following the EFA were retained, resulting in 14 items for attitude toward healthy eating and fruit and vegetables (2 items removed), 7 items for attitude toward snacks and fast food (1 item removed), 4 items for subjective norm regarding healthy eating (2 items removed), 8 items for perceived behavioral control over healthy eating (no items removed), 5 items for intention to eat healthy (no items removed), and 5 items for financial scarcity (no items removed). The remaining items had an acceptable internal consistency/reliability, indicated by Cronbach α ranging from 0.83 to 0.94 (Supplementary Table 2).[35]

A CFA was applied for the remaining items (ie, the items that were not excluded following the EFA) within the constructs, showing moderate model fit (χ^2/df = 3.74; CFI = 0.80, RMSEA [95% confidence interval (CI)] = 0.094 [0.091−0.098]; SRMR = 0.086) and an explained variance of 99% for the overall model (Supplementary Table 3). We used the average scores of the remaining items for each construct in the analyses.

Participant Characteristics

A total of 1,033 participants with oversampling on a relatively lower SEP were included in the current study. Participants had a mean age of 55.5 ± 16.4 years, an approximately equal percentage of men and women were included, and the vast majority of participants were born in the Netherlands (Table 1). Most

Table 1. Population Characteristics for the Total Population (n = 1,033)

Characteristics	Mean ± SD or n (%)
Age, y	55.5 ± 16.4
Age range, y	18–88
Sex, male	542 (52.5)
Country of birth, the Netherlands	999 (96.7%)
Marital status	
Cohabiting with children	202 (19.6)
Cohabiting without children	408 (39.5)
Single with children	101 (9.8)
Single without children	285 (27.6)
Other	37 (3.6)
Educational level	
Low (upper secondary education or lower)	469 (45.4)
Intermediate (postsecondary to short-cycle tertiary education)	506 (49.0)
High (bachelor degree or higher education)	58 (5.6)
Paid employment, yes	429 (41.5)
Income[a]	
Minimum	130 (12.6)
Below mode income	560 (54.2)
Mode income or higher	251 (24.3)
Don't know/don't want to answer	91 (8.9)
Livability index, 1 (poor) to 9 (outstanding)[b]	6.7 ± 1.26
Score ≤ 6	437 (42.4)
Score ≥ 7	594 (57.6)
Lifestyle factors	
Current smoker, yes	183 (17.7)
Body mass index[c]	26.8 ± 5.0
Weight status	
Normal weight	404 (39.1)
Overweight	370 (35.8)
Obesity	259 (25.1)
Dietary quality, 0–130	70.3 ± 15.3
TPB constructs, 7-point Likert scales	
Attitude healthy eating and fruit and vegetables	4.8 ± 0.9
Attitude snacks and fast food	2.9 ± 1.1
Subjective norm	4.3 ± 1.2
Perceived behavioral control	5.0 ± 1.0
Intention	4.7 ± 1.1
Finance-related barriers	
Food insecurity score, range 0–6	0.4 ± 1.2
Financial scarcity, 7-point Likert scale	2.6 ± 1.5

TPB indicates Theory of Planned Behavior.
[a]Income categories refer to the following amounts of annual gross income: minimum < 14.100 euro; below mode income 14.100–36.500 euro; mode income or higher > 36.500 euro; [b]Livability index: n = 1,031; [c]Body mass index: n = 984.

participants had an income below the mode Dutch income or lower (66.8%). Approximately one-quarter of participants were obese (Table 1).

Participants generally did not perceive a strong subjective norm regarding healthy eating. Participants overall showed a positive attitude toward healthy eating and fruit and vegetable consumption and a negative attitude toward snacks and fast-food consumption. Participants generally felt confident about their ability to eat healthy (ie, perceived behavioral control) and generally intended to eat healthy (Table 1).

Compared with participants not experiencing financial barriers, people experiencing food insecurity or financial scarcity generally reported a stronger perceived subjective norm regarding healthy eating ($P < 0.001$), a less positive attitude toward healthy eating and fruit and vegetable consumption ($P < 0.001$ and $P < 0.05$, respectively), and a lower perceived behavioral control ($P < 0.001$) (Supplementary Table 4).

Associations Between Food Insecurity, Financial Scarcity, Attitude, Subjective Norm, Perceived Behavioral Control, Intention, and Dietary Quality

A higher food insecurity score (ie, stronger experienced food insecurity) and a stronger experienced financial scarcity were associated with a lower dietary quality score ($\beta = -1.51$; 95% CI, −2.30 to −0.73; $P < 0.001$; and $\beta = -1.60$; 95% CI, −2.57 to −0.94; $P < 0.001$, respectively) after adjustment for sociodemographic variables (Table 2). Furthermore, a more positive attitude toward healthy eating and fruit and vegetable consumption, a more negative attitude toward snacks and fast-food consumption, higher perceived behavioral control, and higher intention to eat healthy were associated with a higher dietary quality (all $P < 0.001$). No significant association was found between subjective norm and dietary quality. A more positive attitude toward healthy eating and fruit and vegetable consumption, a more negative attitude toward snacks and fast-food consumption, a higher perceived subjective norm, and a higher perceived behavioral control were associated with a higher intention to eat healthy (all $P < 0.001$). Experiencing financial scarcity or food insecurity was not significantly associated with intention. People experiencing food insecurity or financial scarcity had a less positive attitude toward healthy eating and fruit and vegetable consumption, perceived a stronger subjective norm for healthy eating and perceived lower behavioral control (all $P < 0.001$) (Table 2).

The TPB and Extended TPB

Path analyses for the models explaining dietary quality showed that all associations between the constructs constituting the traditional TPB

Table 2. Associations Between Food Insecurity, Financial Scarcity, Attitude, Subjective Norm, Perceived Behavioral Control, Intention, and Dietary Quality

	Crude[a]			Adjusted[b]		
Variables	**β**	**95% CI**	***P***	**β**	**95% CI**	***P***
Outcome: dietary quality						
Food insecurity score	−1.94	−2.71 to −1.18	< 0.001	−1.51	−2.30 to −0.73	< 0.001
Financial scarcity	−1.81	−2.45 to −1.18	< 0.001	−1.60	−2.27 to −0.94	< 0.001
Attitude healthy eating and fruit and vegetables[c]	6.56	5.58–7.55	< 0.001	6.36	5.37–7.35	< 0.001
Attitude snacks and fast food[c]	−3.90	−4.72 to −3.08	< 0.001	−3.05	−3.95 to −2.15	< 0.001
Subjective norm	−0.65	−1.44 to 0.15	0.11	−0.069	−0.89 to 0.76	0.87
Perceived behavioral control	3.25	2.35–4.14	< 0.001	3.34	2.44–4.24	< 0.001
Intention	3.24	2.41–4.06	< 0.001	3.41	2.57–4.24	< 0.001
Outcome: intention						
Food insecurity score	0.006	−0.050 to 0.062	0.84	−0.015	−0.07 to 0.04	0.61
Financial scarcity	0.001	−0.045 to 0.047	0.96	−0.01	−0.06 to 0.04	0.79
Attitude healthy eating and fruit and vegetables[c]	0.54	0.47–0.61	< 0.001	0.55	0.48–0.62	< 0.001
Attitude snacks and fast food[c]	−0.17	−0.23 to −0.11	< 0.001	−0.21	−0.27 to −0.14	< 0.001
Subjective norm	0.37	0.31–0.42	< 0.001	0.39	0.33–0.45	< 0.001
Perceived behavioral control	0.50	0.44–0.56	< 0.001	0.52	0.46–0.58	< 0.001
Outcome: attitude healthy eating and fruit and vegetables[c]						
Food insecurity score	−0.10	−0.14 to −0.06	< 0.001	−0.10	−0.14 to −0.05	< 0.001
Financial scarcity	−0.13	−0.16 to −0.09	< 0.001	−0.12	−0.16 to −0.08	< 0.001
Outcome: attitude snacks and fast food[c]						
Food insecurity score	0.013	−0.04 to 0.07	0.65	−0.01	−0.07 to 0.05	0.73
Financial scarcity	0.029	−0.02 to 0.08	0.21	0.03	−0.02 to 0.08	0.19
Outcome: subjective norm						
Food insecurity score	0.18	0.12–0.24	< 0.001	0.14	0.08–0.20	< 0.001
Financial scarcity	0.13	0.08–0.18	< 0.001	0.10	0.05–0.15	< 0.001
Outcome: perceived behavioral control						
Food insecurity score	−0.14	−0.20 to −0.09	< 0.001	−0.15	−0.21 to −0.10	< 0.001
Financial scarcity	−0.16	−0.20 to −0.12	< 0.001	−0.17	−0.22 to −0.13	< 0.001

CI indicates confidence interval.
[a]Statistical test used: simple linear regression; [b]Statistical tests used: multinomial linear regression, adjusted for age, sex, income, educational level, employment status, marital status, country of birth, and livability index; [c]Attitude scores were reversed (ie, higher scores reflect a more positive attitude).
Note: $P < 0.05$ was considered statistically significant.

(model A) were statistically significant ($P < 0.05$) and in the expected directions: a more positive attitude toward healthy eating and fruit and vegetable consumption, a more negative attitude toward snacks and fast-food consumption, a stronger perceived subjective norm, and a stronger perceived behavioral control were positively associated with a higher intention to eat healthy, and the intention was positively associated with dietary quality ($\beta = 2.6$; 95% CI, 1.62–3.56; $P < 0.001$) (Figure). In the extended TPB, in which financial scarcity and food insecurity scores were added to the model (model E), similar effect estimates were observed for most associations. Notably, a higher experienced financial scarcity was associated with a slightly higher intention ($\beta = 0.08$; 95% CI, 0.036–0.12; $P < 0.001$) and not statistically significantly associated with lower dietary quality ($P = 0.09$). A higher food insecurity score (ie, stronger experienced food insecurity) was not significantly associated with intention or with a lower dietary quality ($P = 0.07$) (Figure).

Fit indices of the 5 models explaining dietary quality (outlined in Supplementary Figure 1; Figure) showed poorest fit for the traditional TPB (model A: χ^2/df = 11; CFI = 0.75; RMSEA [95% CI] = 0.10 [0.091–0.12]; SRMR = 0.05), and best fit for the most extended TPB including financial scarcity and food insecurity (model E: χ^2/df = 3.3; CFI = 0.95; RMSEA [95% CI] = 0.05 [0.035–0.065]; SRMR = 0.018) (Table 3). All 5 structure models explained approximately 42% to 43% of the variance in intention; however, the variance in dietary quality was better explained by the extended TPB models including food insecurity and/or financial scarcity (models C, D and E: 21.6% to

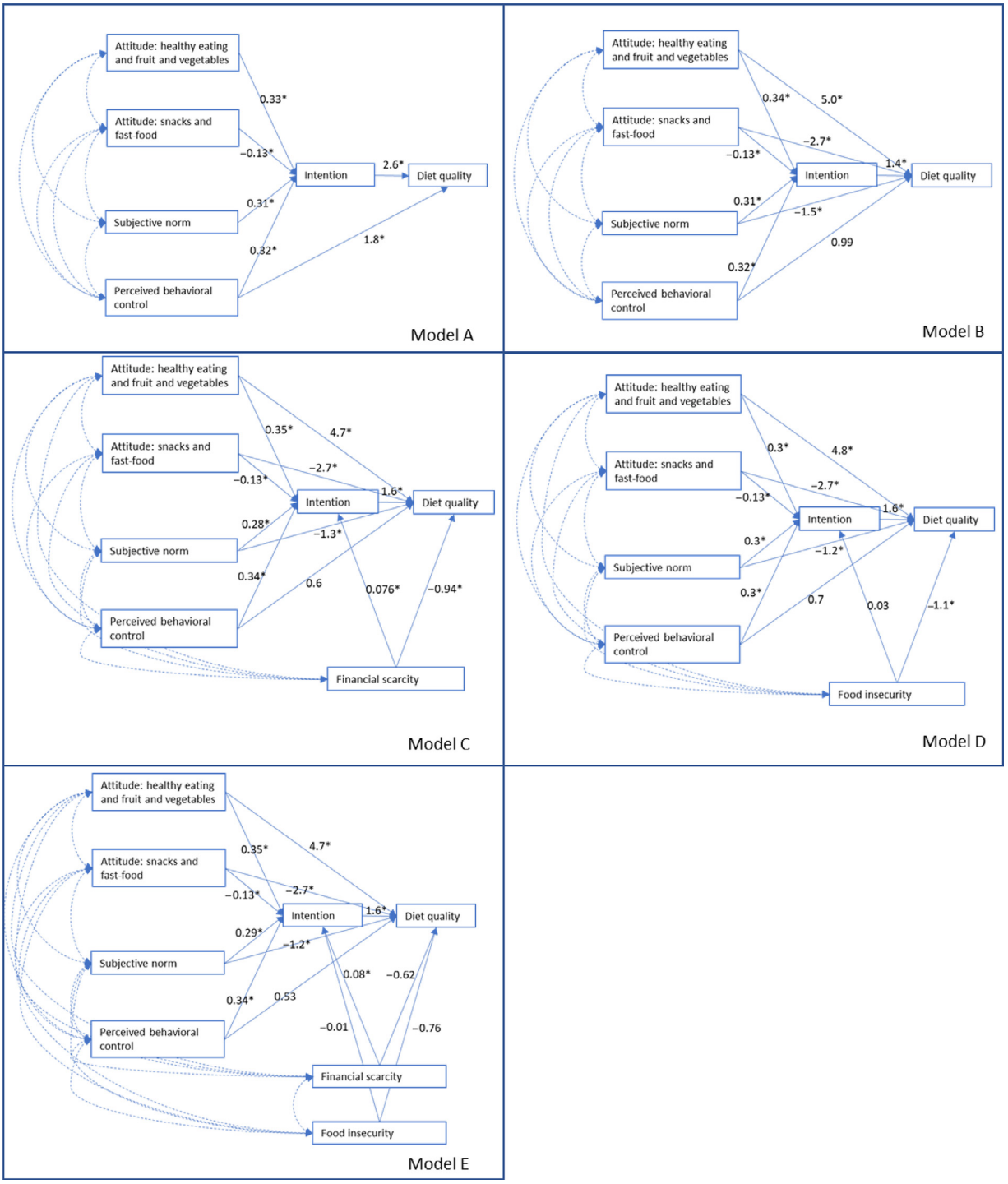

Figure. Path analyses for the models explaining dietary quality. Double (dashed) arrows indicate correlations, single arrows indicate beta coefficients. Model A, traditional Theory of Planned Behavior; model B, model A that also included direct associations between attitude and dietary quality, and between subjective norm and dietary quality; model C, model B that additionally included financial scarcity; model D, model B that additionally included food insecurity; model E, model B that additionally included financial scarcity and food insecurity. All models were adjusted for age, sex, income, educational level, employment status, marital status, country of birth, and livability index. *$P < 0.05$ was considered statistically significant.

21.9%) compared with the traditional TBP (model A, 7.3%) (Table 3). The explained variance of the overall model (ie, how much of the variance in included variables is explained by the total model) improved from 42.5% to 52.3% between model A and E (Table 3).

Table 3. Fit Indices of Models Used to Explain Diet Quality Based on the Theory of Planned Behavior

Indicies	Model A[a]	Model B[b]	Model C[c]	Model D[d]	Model E[e]	Norm Values
Fit index						
χ^2/df	11.09	3.84	3.42	3.49	3.31	≤ 5
CFI	0.749	0.941	0.950	0.948	0.953	≥ 0.90
RMSEA	0.104	0.055	0.051	0.051	0.050	≤ 0.10
(95% CI)	(0.091–0.117)	(0.041–0.070)	(0.036–0.066)	(0.037–0.067)	(0.035–0.065)	
	$P < 0.001$	$P = 0.2$	$P = 0.44$	$P = 0.41$	$P = 0.49$	
SRMR	0.049	0.022	0.019	0.019	0.018	≤ 0.080
Explained variance						
r^2 intention	0.418	0.418	0.427	0.419	0.427	
r^2 dietary quality	0.073	0.209	0.216	0.216	0.219	
r^2 overall model	0.425	0.510	0.522	0.515	0.523	

CFI indicates comparative fit index; CI, confidence interval; df, degrees of freedom; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual.

[a]Model A: traditional Theory of Planned Behavior; [b]Model B: model A that also included direct associations between attitude and dietary quality, and between subjective norm and dietary quality; [c]Model C: model B that additionally included financial scarcity; [d]Model D: model B that additionally included food insecurity; [e]Model E: model B that additionally included financial scarcity and food insecurity.

Note: All structural equation models were adjusted for age, sex, income, educational level, employment status, marital status, country of birth, and livability index.

DISCUSSION

Our study showed that dietary quality was better explained by the extended TPB, including financial scarcity and/or food insecurity, compared with the traditional TPB. Explained variance in dietary quality was approximately 7% for the traditional TPB, whereas the extended TPB showed an explained variance in dietary quality of 22%. Thus, the extended TBP accounts for more variance in dietary quality, indicating that this model better explains differences in dietary quality. However, based on our findings, including both food insecurity and financial scarcity simultaneously is not necessary for explaining differences in dietary quality. These findings highlight the importance of taking into account finance-related barriers for healthy eating like financial scarcity or food insecurity to better understand individual dietary behaviors in lower SEP populations.

Our results showed that the traditional TPB had a limited ability to explain dietary quality, a finding confirmed by others.[4] For example, previous research among Australian pregnant women and a study among a sample of the general population in the United Kingdom showed that the TPB framework can explain intention to eat healthy but explains little variance in actual eating behavior.[36,37] Consistent with these findings, our results showed that the traditional TPB had a reasonable ability to explain intention to eat healthy, whereas the traditional TPB poorly explained dietary quality.

These observations may be explained by the underlying assumption of the TPB that dietary behavior is under an individual's volitional control, implying that dietary decisions are made willingly and rationally. This is partially accounted for by including perceived behavioral control over healthy eating in the TPB.[38] However, clearly, dietary behavior is influenced by contextual factors and availability of resources, and the assumption of having volitional control over dietary behaviors does not hold for individuals experiencing finance-related barriers to healthy eating as reflected by food insecurity and financial scarcity. In addition, previous studies showed that factors such as attitude and subjective norm could also directly influence eating behavior.[39,40] Therefore, we also explored direct associations between attitude and subjective norm with dietary quality, and results of our path analyses showed that these direct associations were indeed significant and that including these direct associations improved the explained variance in dietary quality. Extending the traditional TPB by additionally including financial scarcity and/or food insecurity further improved explained variance in dietary quality. The observed improvement in explained variance in dietary quality from 7% to 22% is substantial when considering the complex nature of dietary behavior.[4]

Our regression analyses showed an association between experiencing food insecurity and poorer dietary quality, which is in line with previous studies.[12] Our results indicate that food insecurity is directly associated with dietary quality, but not with the intention to eat healthy, which is in line with a previous study reporting no differences in intention to eat healthy between food secure and food insecure individuals.[41] This suggests that the generally poorer dietary quality among people experiencing food insecurity is not the result of a lack of intention to eat healthy but may rather be induced by stress, psychosocial barriers, or financial barriers.[9,11]

Comparable to our findings on food insecurity, our regression analyses showed that experiencing financial scarcity was not significantly associated with intention. In contrast, our path analyses, including all TPB constructs and food insecurity, did indicate that experiencing financial scarcity was associated with a

slightly higher intention to eat healthy. Based on the literature, one would expect that (financial) scarcity has a negative impact on the ability to focus on longer-term goals and thus would lead to a lower intention to eat healthy.[19] Therefore, on the one hand, our path analyses results should be interpreted with caution as this association is not confirmed by theory nor by the results of the individual association. On the other hand, this contrasting finding may also be explained by the inclusion of the TPB constructs in the model. The model showed significant negative covariances for financial scarcity with attitude toward healthy eating and fruit and vegetable consumption and perceived behavioral control, and a positive covariance with subjective norm (data not shown). It may be speculated that other constructs related to subjective norms influence the positive association between financial scarcity and intention to eat healthy. For example, people living in poverty may have a higher intention to eat healthy to comply with social norms because of fear of social exclusion. Indeed, a previous study has shown that besides social norms, social exclusion is also an important determinant that needs to be taken into account when addressing health behavior.[42]

In line with previous literature,[12,21] our findings indicate that experiencing financial scarcity or food insecurity is associated with lower dietary quality in the regression analyses and path analyses. However, in the path analyses of the most extended TPB model, including financial scarcity and food insecurity, we did not observe a significant association between these variables and dietary quality. A possible explanation for this finding is that food insecurity and financial scarcity are closely related, explaining part of the association of the other variable with dietary quality.

Although our results showed that the extended TPB improved the explained variance in dietary quality considerably, it should be noted that other factors not included in this study would expectedly play an important role, as a large part of the variance in dietary quality was not well explained by the extended TPB model in this study. Nevertheless, the presented findings further our understanding of dietary behaviors and food choices and highlight the importance of taking finance-related barriers, such as financial scarcity and food insecurity, into account when aiming to understand dietary behavior or improve dietary quality among lower SEP populations.

The findings of this study should be interpreted in light of its limitations. First, all data were self-reported, which may have led to misclassification or biases, such as recall bias and social-desirability bias.[43] To validate our findings, more objective measures would be valuable, especially for the dietary intake assessment. Furthermore, questionnaires were offered in Dutch only, and no help could be provided as questionnaires were completed online and anonymously, thereby excluding non-Dutch speaking and illiterate people. This may explain the disproportionately high number of participants born in the Netherlands and contribute to underestimating food insecurity prevalence in our study—as previous literature indicates that food insecurity prevalence is generally higher among ethnic minority groups.[44] In addition, the high number of participants born in the Netherlands, together with oversampling on lower SEP individuals, limits the generalizability of our results. It should further be noted that not all model fit statistics were above the norm values. Specifically, for the model that included the items within the constructs that remained after the EFA, we found a CFI of 0.8, whereas a norm of 0.9 or higher is considered in methodological literature.[45] However, we found high internal consistency/reliability for the constructs. Furthermore, our extended TPB models, which were the main focus of our study, all had CFI values above the norm values. Our study is further limited by its cross-sectional design, not suitable for conclusions about causality. In addition, no temporal order of the paths between the TPB constructs could be confirmed in our study. A longitudinal study design assessing dietary intake at a later time point than the other TPB constructs would have been preferred and would improve the ability to establish causal pathways leading to dietary quality.

Strengths of the current study include the relatively large sample size and our inclusion of participants living across the Netherlands, including rural and urban districts. Furthermore, TPB constructs were assessed on the basis of a large number of items, and the retained items showed good validity and reliability. In addition, financial scarcity and food insecurity were assessed on the basis of validated scales.

IMPLICATIONS FOR RESEARCH AND PRACTICE

Dietary behavior is complex, and therefore the potential of the TPB to explain dietary behavior seems to be limited. Our results showed that including financial barriers such as financial scarcity or food insecurity in the extended TPB improved the explained variance in dietary quality considerably. However, our findings suggest that other factors not included in this study would expectedly play an important role because a large part of the variance in dietary quality was not well explained by the extended TPB model in this study. Therefore, future studies may consider other potential factors for explaining dietary quality in lower SEP populations or consider a mixed-method approach to understand factors that determine dietary behavior from an individual perspective. Our findings highlight the importance of considering finance-related barriers, such as financial scarcity or food insecurity, when aiming to understand dietary behavior or to improve dietary quality among lower SEP populations.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jneb.2022.02.019.

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