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Validation and dimensional analysis of the eating behaviour pattern questionnaire among Malaysian university students

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ABSTRACT

Introduction: Eating behaviour pattern is among the key behavioural factors that contribute to eating disorders. Hence, to evaluate the psychometric characteristics of the Eating Behaviour Pattern Questionnaire (EBPQ) that is used in epidemiological studies to measure the relationship between health outcomes and eating behaviour patterns, this study aimed to validate the adopted version of the EBPQ and to check the validity and reliability of this tool in University of Malaya, Malaysia. **Methods:** Exploratory factor analysis (EFA) was used to determine the most appropriate factor structure of EBPQ. Moreover, structural equation modelling (SEM) and confirmatory factor analysis (CFA) were applied to examine the convergent and discriminant validity of EBPQ. As for the participants of the study, multi-stage random sampling was used and 200 students (109 females and 91 males) from University of Malaya were chosen. **Results:** The EFA yielded nine components of EBPQ including emotional eating, eating outside, cultural habit, low-fat eating, meal skipping, snacking, healthy eating, planning for food and sweets, which explained 67.7% of the total variance. Furthermore, the Cronbach's α was about 0.8 for all components, which exhibited a high internal consistency among the obtained components. The results showed that the questionnaire had sufficient convergent and discriminant validity. **Conclusion:** The EBPQ was proven to be a reliable tool to measure the eating behaviour patterns in Malaysian university students. The presence of adequate validity and reliability supports this instrument's psychometric properties for future studies.

Keywords: Eating Behaviour Pattern Questionnaire, exploratory factor analysis, confirmatory factor analysis, structural equation modelling

INTRODUCTION

Recently, in both developed and developing countries, chronic diseases cause premature deaths and significant disabilities because of the changes in dietary patterns, eating behaviour,

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and lifestyle (Salekzamani, Asghari-Jafarabadi & Dehghan, 2015). Behavioural factors such as eating behaviour pattern, is one of the most influential factors of weight gain and obesity (Chong *et al.*, 2016). Therefore, modifying these main determinants of chronic diseases could decrease diet-related diseases.

The Eating Behaviour Pattern Questionnaire (EBPQ) is used in epidemiological studies to measure the relationship between eating behaviour patterns and health outcomes, as well as to assess emotional, restrained and external eating behaviours (Van Strien et al., 1986; Cebolla et al., 2014; Dutton & Dovey, 2016).

This questionnaire was adopted from previous studies with 51 items (Salekzamani et al., 2015; Schlundt et al., 2003). No study has yet examined the dimensions of EBPQ in context of Malaysian university students. Hence, this study aims to evaluate the dimensional structure of the adopted version of the EBPQ among Malaysian students, and to assess the instrument's reliability and validity.

MATERIALS AND METHODS

Study design

Structural equation modelling (SEM) is one of the complete and flexible techniques for testing and estimating the structural model of the overall relations among the dimensions of eating behaviour pattern questionnaire. In this study, the psychometric characteristics of EBPQ were checked through parallel analysis (PA) and exploratory factor analysis (EFA). EFA was applied to evaluate the structure and dimensions of the instrument, and confirmatory factor analysis (CFA) was used to assess the measurement model to test its convergent validity and construct reliability. Content validity was done through an expert panel review.

Sample size and sampling method

The participants were randomly selected from University of Malaya (semesters I and II, 2016 and 2017) through multi-stage random sampling technique (Cohen, 2007), with diverse socioeconomic status and without known physical or mental illnesses. A total of 17 faculties within University of Malaya was chosen. First, five faculties were randomly selected based on the highest percentage of students enrolled in each faculty. Second, the portion size and number of samples from different faculties were determined. Third, five departments were randomly chosen from each faculty and the number of classes for each semester was obtained from the administration office of each department. Fourth, the classes were randomly selected and finally the participants were randomly chosen among the local students. A package including the EBPQ, a consent form and information sheet were distributed among the participants. They were asked to complete the questionnaires individually and fill up a self-report demographic questionnaire about their age, educational level (Bachelor, Master, or Doctor of Philosophy degree), marital status (single or married), as well as their income. Other information regarding their weight and height were also self-reported.

The sufficient sample size for factor analysis and SEM was calculated using the power analysis method (Soper, 2015). Accordingly, the amount of β, α, number of latent variables and the number of indicators were fixed. By considering β=0.80, number of latent variables=9, number of indicators=51 items and α=0.05, the least number of sample calculated for partial least squares structural equation modelling (PLS-SEM) equaled to 200.

Ethical approval
Ethical approval was obtained from the Faculty of Medicine, University of Malaya, [UM.TNC2/RC/H&E/UMREC-63].

Study instruments
The original EBPQ used a 5-point Likert scale, from strongly disagree to strongly agree, to evaluate factors on eating behaviour patterns. It consisted of 51 items covering six factors: low-fat eating (11 items), snacking and convenience (10 items), emotional eating (8 items), planning ahead (6 items), meal skipping (7 items), and cultural-lifestyle behaviour (9 items). It also included a socio-demographic part encompassing information on age, gender, marital status, educational level and employment status. Statistical analysis was performed using the SPSS (ver. 23; Inc., Chicago, IL, USA) and Smart PLS (ver.3) was used for CFA analysis.

Dimensional analysis
Factor analysis was used to determine the correlation among the variables in a dataset by using Eigenvalues (Besnoy *et al.*, 2016), which is frequently employed to argue for primary latent factors and/or to validate questionnaires. To signify the number of factors/components, PA was used to reduce type I error as it gives an excessive number of factors. The PA suggested nine factors for the EBPQ, extracted through comparing the Eigenvalues of the actual data and the Eigenvalues of the simulated data (Çokluk & Koçak, 2016).

Exploratory factor analysis
The Kaiser–Meyer–Olkin (KMO) value was over 0.82 for unobserved variables, signifying that the data were appropriate for factor analysis. Accordingly, EFA was performed through the principal axis factoring (PAF) extraction method and the Promax Rotation. Loading values above 0.4 were considered as satisfactory (Chong *et al.*, 2016), while the number of factors (components) was identified based on the PA results.

Reliability
All statistical analyses were done at 95% confidence level. Cronbach's α must be >0.7 and the item-total correlation should be >0.4 for each item. Cronbach's α was calculated to determine the scale's internal consistency for each dimension separately.

Confirmatory factor analysis measurement model
After establishing the components by EFA, the confirmatory factor analysis (CFA) was used to confirm each dimension and that the related items have sufficient construct validity through measurement model. In SEM analysis, measurement model is used to verify the convergent and discriminant validity. The measurement model deals with the relations between the latent (each component) and observed variables (related questions). It tests the reliability of the observed variables used to assess the latent variables. The CFA is used to assess the relationship between the indicators and associated latent variables. If the measurement model poorly fits the data, this means that some of the observed indicator variables are not reliable, thus preventing the researcher from proceeding to analyse the structural model. The items with low factor loadings are excluded from the measurement model. Moreover, when the fitness indices have reached the requirement level, the construct validity is achieved.

Convergent validity
Convergent and discriminant validity are the two main parts of CFA analysis. The convergent validity denotes the extent to which the indicators set can measure a construct. It is possible to evaluate the convergent validity at construct level through the average variance extracted.

Therefore, composite reliability (CR) >0.7 is acceptable. The average variance extracted (AVE) should be ≥0.5 (Hair Jr *et al.*, 2016).

Discriminant validity

The discriminant validity reveals that each construct measurement should be different from other constructs. Therefore, for assessing the discriminant validity, the Fornell-Larcker criterion was used (Fornell & Larcker, 1981).

RESULTS

Demographic characteristics are reported in Table 1. Exploratory factor analysis showed that a total of nine constructs were extracted from the data through PAF extraction method and the Promax Rotation method. The total variance for the EBPQ was 67.7%. The first component or emotional eating with seven items included about 10.3% of the total variance. This percentage was followed by eating outside at about 9.0% (six items), cultural habit (five items) at 7.0%, low-fat eating (six items), meal skipping (five items), snacking (five items), healthy eating (five items), planning for food (five items), and sweets (four items).

Cronbach's α for all the components was satisfactory (α>0.8). The emotional eating sub-scale consisted of eight items (α=0.933). The next components were those with six items, including "low-fat eating" (α=0.910), "cultural habit" (α=0.923) and "eating outside" (α=0.932). The rest were components with five items, including "healthy eating" (α=0.903), "snacking" (α=0.908), "planning for food" (α=0.899) and "meal skipping" (α=0.937). The "sweets" component had four items (α=0.933).

SEM analysis showed that all the items based on the CFA were aligned to the established components by EFA. CFA analysis also revealed that all constructs (components) had sufficient internal consistency, convergent and

Table 1. Demographic characteristics of participants, N=200

Characteristics	*Mean±SD*	*n (%)*
Age (years)	27.2±3.4 Range (22-36 years)	
BMI (kg/m^2)	23.8±4.95 Range (16.0-55.2)	
Gender		
Male		91 (45.5)
Female		109 (54.5)
Educational Level		
Diploma		2 (1.0)
Bachelor		134 (67.0)
Master		55 (27.5)
Doctor of Philosophy		9 (4.5)
Marital status		
Single		132 (66.0)
Married		68 (34.0)
Occupational status		
Employed		18 (4.0)
Unemployed		182 (91.0)

Table 2. Outer loading value and convergent validity for EBPQ

Items	*Outer Loading*	*CR*	*AVE*
Eating outside		0.939	0.719
EBP1	0.846		
EBP13	0.832		
EBP42	0.856		
EBP43	0.875		
EBP44	0.858		
EBP50	0.820		
Emotional eating		0.941	0.690
EBP2	0.854		
EBP8	0.794		
EBP9	0.849		
EBP14	0.826		
EBP19	0.828		
EBP27	0.884		
EBP32	0.776		
Skipping meal		0.899	0.654
EBP17	0.897		
EBP25	0.391		
EBP36	0.881		
EBP37	0.870		
EBP48	0.882		
Planning for food		0.812	0.465
EBP7	0.646		
EBP20	0.641		
EBP26	0.769		
EBP35	0.637		
EBP47	0.707		
Snacking		0.931	0.731
EBP5	0.858		
EBP10	0.882		
EBP16	0.848		
EBP21	0.877		
EBP41	0.809		
Low-fat eating		0.931	0.691
EBP3	0.781		
EBP4	0.807		
EBP11	0.835		
EBP29	0.890		
EBP39	0.857		
EBP49	0.814		
Sweets		0.953	0.834
EBP12	0.926		
EBP30	0.925		
EBP40	0.898		
EBP46	0.903		
Healthy eating		0.928	0.721
EBP6	0.850		
EBP18	0.900		
EBP22	0.846		
EBP24	0.848		
EBP45	0.798		

discriminant validity.

Indeed, the factor loading results supported the results of the factor analysis. All outer loadings were >0.700. However, item 38 (from low-fat eating), item 8 (from emotional eating) and item 51 were removed as their loading values were <0.400 (Table 2). The indicator reliability was assessed by outer loadings, yet, Cronbach's α is the conventional criterion for internal consistency. Results indicated that both criteria (CR and Cronbach's α) were satisfactory and that the instrument had sufficient internal consistency.

According to Table 2, CR was in the range of 0.812 to 0.933. CR was introduced to measure internal consistency reliability. AVE was >0.650 for all constructs, except for planning for food. However, if the AVE value was not satisfactory, the researcher may decide to keep or remove that particular construct. In this case, if the CR was >0.7, then that construct may be retained (Hair Jr *et al.*, 2016). The convergent validity was assessed through satisfactory level of CR and AVE. Therefore, each set of specific questions could only measure the specific component (i.e., four questions specifically could measure the sweet component).

The discriminant validity was assessed. According to the results of Fornell-Larcker method for each construct, the AVE was more than every squared correlation between the constructs (Table 3). Consequently, all constructs in the measurement model, which were based on the questionnaire (EBPQ), had sufficient discriminant validity, which meant that each component measured different concepts.

DISCUSSION

The current study enjoyed novelty in terms of presenting the adopted version of the EBPQ among Malaysian students. The strong point of this study was using advanced methods of analysis such as parallel analysis for psychometric analysis, power analysis to apply adequate sample size and SEM analysis.

The components of EBPQ were determined, and the validity and reliability of EBPQ were checked. Using the exploratory factor analysis, components of EBPQ were extracted including items describing eating behaviour patterns that were related to unhealthy and healthy eating behaviours. The final EBPQ was reconstructed with 48 items. Three items including items 8, 38 and 51 were removed due to factor loadings <0.400. These findings were in line with

Table 3. Discriminant validity

EBPQ	*EM*	*HE*	*EO*	*S*	*MS*	*SN*	*LF*	*PL*	*CH*
Emotional eating	0.685								
Healthy eating	0.019	0.806							
Eating outside	0.229	-0.123	0.729						
Sweets	0.429	0.166	0.299	0.754					
Meal skipping	0.250	0.311	0.105	0.359	0.756				
Snacking	0.594	-0.035	0.374	0.361	0.222	0.768			
Low-fat eating	0.053	0.141	0.066	-0.017	0.074	0.129	0.687		
Planning food	-0.043	0.150	0.001	0.193	0.101	-0.017	0.383	0.662	
Cultural habits	0.271	0.031	0.227	0.277	0.172	0.241	-0.016	0.140	0.698

EM: emotional eating; HE: healthy eating; EO: eating out; SB: sweets; MS: meal skipping; SN: snacking; LF: low-fat eating; PL: planning food; CH: cultural habits

the original factor structure (Van Strien *et al.*, 1986). Similarly, in another study, these three items were also removed from further analysis due to issues with factor structure (Cebolla *et al.*, 2014). The original EBPQ was established with six factors (Schlundt 2003).

Similarly, the "low-fat eating" sub-scale was split into healthy eating and low-fat eating (Kee *et al.*, 2008). The "snacking and convenience" factor was split into three sub-scales - snacking, eating out, as well as sweets. Therefore, the nine patterns of eating behaviours identified were (1) emotional eating, (2) eating outside, (3) cultural habits, (4) low-fat eating, (5) meal skipping, (6) snacking, (7) healthy eating, (8) planning for food and (9) sweets. Cronbach's α revealed a high internal consistency among the items of each component. Independent factors in the EBPQ denoted that multiple dimensions characterised youth eating behaviours, while previous studies have used the EBPQ to show a unitary construct (Goldbacher *et al.*, 2012). It might be concluded that the EBPQ does not replace traditional dietary assessment methods. Instead, it is a measurement of eating patterns that is possibly pertinent to disease prevention and health outcomes.

Another aim of this study was to assess the internal structure of the EBPQ and to evaluate the instrument's validity and reliability. The result showed that the EBPQ has adequate psychometric characteristics and can be used in clinical practice to better understand eating behaviour patterns. Moreover, the discriminant validity was assessed and the results indicated that the nine-factor EBPQ has adequate discriminant validity. Therefore, the individual differences in choosing healthy or unhealthy eating behaviour pattern may not reflect anything more than a general eating behaviour pattern. The results of discriminant validity also showed that each unique dimension of EBPQ was distinct from one another. The findings were consistent with those of a similar nature (Salekzamani *et al.*, 2015). The findings verified that the adopted version of the EBPQ had the theoretical factor structure. Furthermore, previous evaluations of the EBPQ's factor structure were limited to the samples of normal weight children and binge-eating women with low diversity (Schlundt *et al.*, 2003). This research presented good information about the factor structure in a more heterogeneous sample.

CONCLUSION

The EBPQ was a suitable tool for measuring the eating behaviour pattern of the participants and it was consistent throughout. However, the exclusion criteria (e.g., the absence of significant medical conditions and the ability to be physically active) limited the possibility of generalising these findings to the general public. Thus, future direction for similar studies is to apply EBPQ in larger sample sizes containing all categories of the society. The findings could be used for further statistical and epidemiological research to understand the psychometric characteristics of research instruments.

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Authors' contribution

MK, involved in sample collection, data analysis, computational analyses, result interpretation, manuscript drafting and revision; AAS, designed and supervised the study, collected the samples, drafted, revised and critically reviewed the manuscript; AFM, designed and supervised the study and critically reviewed the manuscript; MD, performed computational analyses and involved in data analysis, result interpretation, and manuscript revision, designed and supervised the study and critically reviewed the manuscript. All authors have final approval on the manuscript to be published.

Conflict of interest

This manuscript has not been published elsewhere and is not under consideration by other journals. All authors have approved the manuscript and agree with submission to the Malaysian Journal

of Nutrition. We declare that there is no conflict of interest regarding the publication of this study.

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