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Validation of a Sustainable Diet Index among young Malaysian adults

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ABSTRACT

Introduction: A sustainable diet which is healthy and environmentally friendly provides the means of climate change mitigation in addition to promoting health of the population. There is an urgent need to have an indicator to measure if one's diet is sustainable. This paper aimed to validate a newly developed Sustainable Diet Index (SDI) among young Malaysian adults. The SDI was developed based on the dietary guidelines of a sustainable diet. **Methods**: Five indicators (rice, animal-based food, plant-based food, food waste, and packaging) were included in the SDI. The index was validated via content validity, exploratory factor analysis (EFA), and confirmatory factor analysis (CFA) among young Malaysian adults. The dietary assessment tool used was an Android application named Sustainable Food Record. **Results**: Content validity showed fair to moderate correlations (0.331 - 0.816) between the indicators in the SDI. EFA produced five final factors with eight indicators in the index as follows: 1) fruits and vegetables; 2) dairy, eggs, and meat; 3) rice, cereals, and grain products; 4) food packaging; and 5) food waste management with strong factor loadings (0.760 – 0.984). All five factors with eight indicators were retained and proceeded with CFA. The fit indices from CFA demonstrated that the model was an absolutely fit. **Conclusion**: The validated SDI can be used as a tool to measure the sustainability of an individual's diet in Malaysia, incorporating both health and environment considerations.

Keywords: environment, health, sustainable diet index, validation

INTRODUCTION

Sustainable diets are protective and respectful of biodiversity and eco-systems, culturally acceptable, accessible, economically fair and affordable, nutritionally adequate, safe and healthy, while optimising natural and human resources (FAO, 2010). Previous studies and existing guidelines suggest to reduce meat intake and substitute them with plant-based protein, increase the consumption of vegetables and fruits, choose seasonal and local products, choose organic foods, and opt for drinks in recyclable packaging (NHMRC, 2013; Fischer & Garnett, 2016) to achieve a sustainable healthy diet (Lagerberg, 2013).

National dietary guidelines are the main sources of reference for recommendations on healthy diets for the population. Food Climate Research Network (FCRN) (2016) reported that out of 83 available dietary guidelines

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globally, only four countries (Brazil, Germany, Sweden, and Qatar) considered sustainability factors or ecological concerns in their main messages (Fischer & Garnett, 2016). Diet has a direct effect on human health and well-being; while its indirect effects on the environment was newly introduced via the concept of sustainable diet (FAO, 2010).

Globally, there are few studies that focus on environmental sustainability, food system, assessment of sustainable diet and healthy diet. The Environment Performance Index (EPI) was developed as a performance indicator on environmental areas of a country (Hsu & Zomer, 2014). Besides, the Food Sustainability Index (FSI) was also developed to assess the sustainability of a food system (The Economist Intelligence Unit & Barilla Center for Food & Nutrition, 2017). On the other hand, the Diet-related Greenhouse Gas Index was developed to assess the environmental impact of Danish diet (Lund *et al.*, 2017). As for the assessment of healthy and sustainable diet at an individual level, two Sustainable Dietary Indices (SDI)s were developed for the French and Australian population, respectively (Harray *et al.*, 2015; Seconda *et al.*, 2019).

The general Malaysian diet was found to be low in carbon footprint, where some ethnic groups contributed more carbon footprint emission than others (Moy *et al.*, 2020). Adaptation of a sustainable diet can improve the qualities of diet and environment in the long term. The roles of individuals in making changes to environmental issues like climate change are under-estimated as it is hard for individuals to appreciate the significance of the cumulative impact from their small actions (Dahl, 2012). An assessment of the population's diet in terms of its contribution to health and environment will provide explanation and increase the awareness on sustainable diets. However, there is no available indicator assessing the sustainability of our country's diet. To fill this gap, an SDI was developed to measure the sustainability of the Malaysian diet. This paper described the validation of the SDI using exploratory and confirmatory factor analyses among young Malaysian adults.

MATERIALS AND METHODS

The SDI was developed based on the Malaysian Dietary Guidelines (MDG) 2010 and other countries' dietary guidelines that included sustainability or environmental aspects in their recommendations (Sustainable Development Commission, 2009; Health Council of the Netherlands, 2011; Williamson, 2011; Fogelholm, 2013; Lagerberg, 2013; NHMRC, 2013; Oberritter *et al.*, 2013; Constante Jaime *et al.*, 2014; Garnett *et al.*, 2014; Seed, 2014; Montagnese *et al.*, 2015; Ruini *et al.*, 2015). This index is intended to measure the level of healthy and sustainable diet behaviours among Malaysian adults.

Under this health proxy, the scoring method used in the Malaysian Diet Quality Index study was adapted (Fokeena, Jamaluddin & Khaza'ai, 2016). A maximum score of five was allocated when the recommended intake of servings per day was met. As for the environment proxy, the same scoring method in the France SDI was adapted, where median of the food carbon footprint was used as the cut-off value (Seconda *et al.*, 2019). The Comstock 6-point scale method was used to evaluate food waste percentage (Comstock, St Pierre & Mackiernan, 1981). Meanwhile, the score for the management of food waste and packaging were allocated according to the waste management hierarchy in the Waste Hierarchy Guidance using the Waste Management Pyramid (DEFRA,

Table 1. Scoring methods for health indicators, food waste and management of packaging used

Environmental indicators	*Score*					
	5	*4*	*3*	*2*	*1*	*0*
Percentage	0–10%	25%	50%	75%	90%	100%
Food waste management	0 waste	re-use/ give to others	animal feed	composting	other recovery	disposal
Management of packaging used	0 waste	re-use	give to other	recycling	other recovery	disposal

2011). Table 1 presents the scoring system for all indicators.

The sum of all indicators in both proxies were then summed up. The scores for health and environment proxies contributed to 50% each. Both scores were summed up and the final SDI score that ranged from 0 to 100 was derived. Higher SDI score indicated better compliance towards the practice of a healthy and sustainable diet. The development of SDI was published elsewhere (Zulkefli & Moy, 2021).

This study was of cross-sectional design among students from a public university in Malaysia. Hair *et al.* (2014) proposed that a sample size of 100 was adequate for the calculation of correlations between variables. Participants' recruitment was carried out by email invitations to all students via their official university emails. Promotion posters were also distributed within the campus. Their participation was voluntary. The inclusion criteria were students from that particular university, Malaysian citizen, and using a smartphone with Android operating system. Meanwhile, individuals who were pregnant or breastfeeding and following a restrictive diet were excluded.

Ethics approval from the University Malaya Ethics Committee (Reference Number: UM.TNC2/UMREC - 478) was obtained before the study was conducted. Permission from the university's Student Affair Division was also obtained. Written informed consent was obtained from all participants. The participants were randomly divided into two groups. Content validity and exploratory factor analysis (EFA) were carried out among participants in Group 1 (n=100), while confirmatory factor analysis (CFA) was carried out in Group 2 (n= 51).

An android application named Sustainable Food Record (SFR) was developed to upload food images (foods or dishes and drinks in a meal) taken using smart phones to be used as a dietary assessment tool for the index, similarly as reported by Harray *et al.* (2015). Participants were required to capture images of foods and drinks taken before and after eating occasions. The images were captured and uploaded in the SFR application from two different angles (45° and 90°) on all meals taken for three days. The food image recognition and quantification executed by SFR were conducted manually by the researchers. The food images demonstrated acceptable relative validation and reliability for the macro- and micronutrients intakes when tested against the traditional 24-hour diet recall (Ho *et al.*, 2021).

Content and construct validation were conducted to validate the SDI. Content validity is defined as the extent to which the items selected represent a summated scale and its conceptual definition (Joseph *et al.,* 2014). Content validation was carried out by assessing the correlation between the individual indicators and the index. Construct validation was assessed using EFA and CFA (Hurley *et al.,* 1997). Construct validation using factor analysis was conducted to confirm the indicators belonged to the same group as allocated. Principal component analysis (PCA) with Promax rotation was used in EFA. CFA maximum likelihood (ML) was assessed via AMOS (Analysis of Moment Structures) version 20 to confirm the underlying factor structure and model fit of the data. The study sample used for CFA was mutually exclusive from samples used in EFA analysis. Descriptive statistics were presented as frequencies (*n*) and percentages (%) or means and standard deviations (*SD*). Results with *p*-values of <0.05 were considered statistically significant. All statistical analyses were conducted using the Statistical Package for Social Sciences version 17.0 software (SPSS, Inc. Chicago, IL, USA) and Microsoft Excel spreadsheet.

RESULTS

A total of 185 students participated in the study where 151 students were included in the analysis as 34 were excluded due to non-eligibility, withdrawal from the study, and missing data. Most participants were females (70.9%), half were of Chinese ethnic origin, slightly more than half were from Science background and in undergraduate study. Their mean±*SD* age was 24.7±5.2 years old (Table 2).

In content validation, all indicators, with the exception of indicators E1, E2, and E5, showed fair to strong correlations with the SDI (*R*=0.331-0.721). Negative correlation was found between E1 (*R*=-0.250) with the SDI. In addition, health proxy (*R*=0.816) correlated better with the SDI as compared to the environment proxy (*R*=0.408) (Table 3).

Table 2. Demographic characteristics of participants

Characteristics	*Total*	*EFA (n=100)*	*CFA (n=51)*
	n (%)	*n (%)*	*n (%)*
Gender			
Male	44 (29.1)	27 (27.0)	17 (33.3)
Female	107 (70.9)	73 (73.0)	34 (66.7)
Ethnicity			
Malay	54 (35.8)	39 (39.0)	15 (29.4)
Chinese	88 (58.3)	54 (54.0)	34 (66.6)
Indian	7 (4.6)	6 (6.0)	1 (2.0)
Other	2 (1.3)	1 (1.0)	1 (2.0)
Students' background			
Art-based	61 (40.4)	44 (44.0)	17 (33.3)
Science-based	90 (59.6)	56 (56.0)	34 (66.7)
Level of study			
Undergraduate	85 (56.3)	53 (53.0)	32 (62.7)
Master	51 (33.8)	34 (34.0)	17 (33.3)
PhD	15 (9.9)	13 (13.0)	2 (4.0)
Accommodation			
University's hostel	109 (72.2)	66 (66.0)	43 (84.3)
Out of campus	42 (27.8)	34 (34.0)	8 (15.7)
Age in years (Mean±*SD*)	24.7±5.2	24.8±5.1	24.6±5.3

Table 3. Correlation between all indicators with total SDI

	Mean±SD	*Pearson correlation coefficient*	*p-value*
Total SDI	68.41±7.83		
Health proxy	28.25±7.29	0.816	<0.001
H1	8.11±3.55	0.331	0.001
H2	6.51±2.62	0.351	<0.001
H3	13.64±5.34	0.721	<0.001
Environment proxy	41.16±4.61	0.408	<0.001
E1	8.03±1.86	-0.250	0.012
E2	8.42±1.31	-0.047	0.645
E3	1.55±0.50	0.462	<0.001
E4	7.28±2.95	0.399	<0.001
E5	9.68±0.69	0.105	0.297

H1= Fruits and vegetables (portion size); H2= Meat (portion size); H3= Rice (portion size); E1= Fruits and vegetables (carbon footprint); E2= Meat (carbon footprint); E3= Rice (carbon footprint); E4= Food packaging; E5= Food waste

The following results: KMO=0.501; Bartlett test: χ^2=166.35, df=28 (p<0.001) indicated that the data were suitable for factor analysis. PCA with Promax rotation produced a five-factor solution with eigenvalues above 1.0, accounting for 82.7% of total variance (Table 4). The total variance of 82.7% suggested satisfactory results to ensure practical significance for the derived factors.

After EFA, there were five factors with high factor loadings (0.760–0.984) retained (Table 5). However, there was some modification in the grouping of indicators as suggested by EFA. H1 and E1 were grouped as F1, while H2 and E2 were combined into one factor, F2. Similarly, H3 and E3 were placed into the same factor as F3. Meanwhile, E4 and E5 both remained within their individual groups, F4 and F5, respectively. Two of the indicators, E1 (-0.948) and E2 (-0.788) produced negative factor loadings.

Table 4. Results of factor extraction using principal component analysis with promax rotation

Factor	*Initial eigenvalues*			*Extraction sums of squared loadings*			*Rotation sums of squared loadings*†
	Total	*% of variance*	*Cumulative %*	*Total*	*% of variance*	*Cumulative %*	*Total*
1	1.99	24.93	23.93	1.99	24.93	24.93	1.93
2	1.41	17.58	42.50	1.41	17.58	42.50	1.37
3	1.13	14.16	56.66	1.13	14.16	56.66	1.21
4	1.08	13.51	70.17	1.08	13.51	70.17	1.10
5	1.00	12.54	82.70	1.00	12.54	82.70	1.05

†When factors are correlated, sums of squared loadings cannot be added to obtain a total variance

Table 5. Rotated factor matrix for all indicators

Indicators	*Factors*†				
	F1	*F2*	*F3*	*F4*	*F5*
F1: Fruits and vegetables					
H1 Serving size	0.958				
E1 Carbon footprint	-0.948				
F2: Dairy, meat, chicken, and fish					
H2 Serving size		0.849			
E2 Carbon footprint		-0.788			
F3: Rice, cereals, and grain products					
H3 Serving size			0.779		
E3 Carbon footprint			0.760		
F4: Food packaging					
E4 Waste management				0.925	
F5: Food waste					
E5 Percentage and waste management					0.984

†Factors: F1:Fruits and vegetables; F2:Dairy, meat, chicken, and fish; F3:Rice, cereals, and grain products; F4:Food packaging; F5:Food waste (*N*=100)

The final five factors and their distribution of indicators previously extracted from EFA were tested for CFA. The fit indices demonstrated that the model with five factors and eight indicators was an absolute fit (χ^2=5.844, df=12, χ^2/df=0.487, GFI=0.972, NFI=0.955, CFI=1.000, AGFI=0.916, RMSEA=0.000, TLI=1.142).

DISCUSSION

Majority of the participants were young adults, females, and undergraduate students. The higher response rate among females was expected as the Malaysia Higher Education Institutes (2018) reported that the ratio of male to female was 1:1.6 in public institutions (Ministry of Education Malaysia, 2018).

The content validation showed that all indicators exerted substantial contribution on the participants' scoring and ranking in the index (Seconda *et al.*, 2019). The results showed fair to moderate correlations between the indicators and the SDI. There were negative correlations between the environmental indicators for plant-based and meat-based food in terms of their carbon footprint with total SDI. Higher score on the food's carbon footprint reduced the overall SDI score, which indicated less sustainable diet practice.

Our results showed that the indicators under the health proxy were highly correlated with the SDI. However, Seconda *et al.* (2019) found environment proxy to be better correlated with their SDI. The difference might be due to different indicators used in each index, different dietary patterns among the populations, and the different sources of carbon footprint data used in the calculation (Garnett *et al.,* 2014; Seed, 2014; Ho *et al.,* 2021).

EFA produced a five-factor structure which explained 82.7% of the variance. All eight original indicators were retained as they had high factor loadings. Indicators were grouped into their own respective food groups, regardless of their representativeness in health or environment proxies. Portion size and carbon footprint of each food group were combined into one factor, instead of separately by health and environmental factors. For example: H1 (fruits and vegetables, portion size) was grouped with E1 (fruits and vegetables, carbon footprint) into one factor, F1. This applied to F1, F2, and F3. These results might be due to the use of serving size in calculating both health and environmental impacts from the indicators.

Two of the indicators, E1 (fruits and vegetables) and E2 (meat) showed negative correlations or negative direction of the correlation, but only E1 was statistically significant. This does not affect the interpretation of the magnitude of the factor loading or the number of factors to retain (Yong & Pearce, 2013).

The final factors generated from EFA to be included in the SDI were: 1) fruits and vegetables; 2) meat, chicken, dairy, and fish; 3) rice, cereals, and grain products; 4) food waste; and 5) food packaging management. These final factors confirmed through CFA had good model fit. These factors are representative of the Malaysian diet where rice is the main staple of the country. The internal validation of the SDI is now complete and can be used for further assessment on the practice of sustainable diet among the population.

Our developed SDI differed from the other existing sustainable diet indices globally. It was developed based on a few dietary guidelines on sustainability and the MDG. The different categories incorporated in the index provided information to determine the barriers to practising a sustainable diet. Most of the other national SDIs were based on the definition of sustainable diet itself with focus on food groups, without incorporating environmental aspects, such as food waste and management, of food packaging. This may be the strength of our index as our SDI has included these two components, which contribute significantly to the environment (DEFRA, 2011).

A few limitations of this study need to be considered while interpreting the results. Firstly, the study sample was limited to university students and almost 60% were from the Chinese ethnic group. Thus, this population may not represent the general population as they were young adults with higher education level and there was low representation from the Malay and Indian respondents. Besides, since the MDG was used as a reference, the developed SDI is therefore only exclusive for the Malaysian population and not for people of other countries. In addition, the MDG 2010 was used in the current study, while MDG 2020 was just launched recently. Hence, the current SDI may need to incorporate the MDG 2020 in the future. Its validity, however, may be affected and should be re-established as there are variations in the serving sizes for food groups in the MDG 2020. Nevertheless, the validated SDI can be a pioneer in setting an easy and measurable indicator in the field of sustainability, incorporating both health and environmental aspects.

CONCLUSION

In summary, the validated SDI provides a novel and feasible method to measure the sustainability of eating practices at an individual level among the young Malaysian adult population. Future studies could further validate the SDI in more diverse adult population across Malaysia in terms of age and occupation groups.

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Authors' contributions

NFZ & FMM, conceptualised and designed the study; NFZ, prepared the draft of the manuscript and reviewed the manuscript; FMM, advised on data analysis and interpretation, and reviewed the manuscript.

Conflict of interest

None.

References

Comstock EM, St Pierre RG & Mackiernan YD (1981). Measuring individual plate waste in school lunches. Visual estimation and children's ratings vs. actual weighing of plate waste. *J Am Diet Assoc* 79(3):290-296.

Constante Jaime P, Augusto Monteiro C, Martins AP, Martins C, Canella D, C Coitinho D, Jacoby E, Lima F, Cannon G, Moubarac J-C, Garzillo J, Baraldi L, Barciotte M, Louzada ML, Claro R, Rodrigues R, Levy R & Domene S (2014). Dietary Guidelines for the Brazilian Population. From: https://www.fao.org/nutrition/education/food-dietary-guidelines/regions/brazil/en/ [Retrieved January 14 2021]

Dahl AL (2012). Achievements and gaps in indicators for sustainability. *Ecological Indicators* 17:14-19. https://doi.org/10.1016/j.ecolind.2011.04.032 [Retrieved 14 January 2021]

DEFRA (2011). Guidance on Applying the Waste Hierarchy. Department for Environment Food and Rural Affairs (DEFRA), London, UK

Fischer CG & Garnett T (2016). Plates, pyramids, planet: Developments in national healthy and sustainable dietary guidelines: a state of play assesment. FAO and the University of Oxford.

Fogelholm M (2013). New Nordic Nutrition Recommendations are here. *Food Nutr Res* 57: 10.3402/fnr.v3457i3400.22903. Doi: 10.3402/fnr.v57i0.22903

Fokeena WB, Jamaluddin R & Khaza'ai H (2016). Development and assessment of the reliability and validity of a Diet Quality Index in a sample of Malaysian university students. *J Food Nutr Res* 4(4):251-257.

FAO (2010). Definition of Sustainable Diets. Food and Agriculture Organization. International Scientific Symposium: Biodiversity and Sustainable Diets, United Against Hunger.

Garnett T, Appleby M, Balmford A, Bateman I, Benton T, Bloomer P, Burlingame B, Dawkins M, Dolan L & Fraser D (2014). What is a sustainable healthy diet? A discussion paper. Oxford, United Kingdom: Food Climate Research Network (FCRN). From: https://ccafs.cgiar.org/resources/publications/what-sustainable-healthy-diet-discussion-paper [Retrieved January 28 2021]

Hair JF, Black WC, Babin BJ, Anderson RE & Tatham RL (2014). *Análise Multivariada de Dados (Multivariate Data Analysis)* (6th ed.). Bookman, Porto Alegre.

Harray AJ, Boushey CJ, Pollard CM, Delp EJ, Ahmad Z, Dhaliwal SS & Kerr DA (2015). A novel dietary assessment method to measure a healthy and sustainable diet using the mobile food record: Protocol and methodology. *Nutrients* 7(7):5375-5395. Doi: 10.3390/nu7075226

Health Council of the Netherlands (2011). Guidelines for a healthy diet: the ecological perspective, Health Council of the Netherlands, The Hague, Netherlands.

Ho DKN, Chiu WC, Lee YC, Su HY, Chang CC, Yao CY & Chang JS (2021). Integration of an image-based dietary assessment paradigm into dietetic training improves food portion estimates by future dietitians. *Nutrients* 13(1):175.

Hsu A & Zomer A (2014). Environmental performance index. In: N Balakrishnan, T Colton, B Everitt, WW Piegorsch, F Ruggeri, JL Teugels (eds). *Wiley StatsRef: Statistics Reference Online* (pp.1-5). John Wiley & Sons, Inc, Hoboken, New Jersey.

Hurley AE, Scandura TA, Schriesheim CA, Brannick MT, Seers A, Vandenberg RJ & Williams LJ (1997). Exploratory and confirmatory factor analysis: Guidelines, issues, and alternatives. *J Organ Behav* 18(6):667-683.

Joseph F, Hair J, Black WC, Babin BJ & Anderson RE (2014). Multivariate Data Analysis, Pearson Education.

Lagerberg FC (2013). Towards environmentally sound dietary guidelines. Centre for Sustainable Agriculture, Swedish University of Agricultural Sciences, Uppsala.

Lund TB, Watson D, Smed S, Holm L, Eisler T & Nielsen A (2017). The Diet-related GHG Index: construction and validation of a brief questionnaire-based index. *Climatic Change* 140(3):503-517.

Ministry of Education Malaysia (2018). Quick Facts 2018: Malaysia Educational Statistics. Ministry of Education Malaysia, Putrajaya. ISBN:1985-6407.

Montagnese C, Santarpia L, Buonifacio M, Nardelli A, Caldara AR, Silvestri E, Contaldo F & Pasanisi F (2015). European food-based dietary guidelines: a comparison and update. *Nutrition* 31(7-8):908-915.

Moy FM, Eng JY, Zulkefli NF, Ng LL & Ismail MA (2020). Is the diet of a middle income country sustainable? An exploratory study from Malaysia. *Preprints* 2020:2020080006. From: https://www.preprints.org/manuscript/202008.0006/v1 [Retrieved March 7 2021]

NHMRC (2013). Australian Dietary Guidelines National Health and Medical Research Council, Canberra. ISBN: 1864965754.

Oberritter H, Schäbethal K, von Ruesten A & Boeing H (2013). The DGE-Nutrition Circle–representation and fundamentals of the food-based recommendations of the German Nutrition Society. *Ernahr Umsch International* 2(2013):25.

Ruini LF, Ciati R, Pratesi CA, Marino M, Principato L & Vannuzzi E (2015). Working toward healthy and sustainable diets: The "Double Pyramid Model" developed by the Barilla Center for Food and Nutrition to raise awareness about the environmental and nutritional impact of foods. *Front Nutr* 2:9.

Seconda L, Baudry J, Pointereau P, Lacour C, Langevin B, Hercberg S, Lairon D, Allès B & Kesse-Guyot E (2019). Development and validation of an individual sustainable diet index in the NutriNet-Santé study cohort. *Br J Nutr* 121(10):1166-1177.

Seed B (2014). Sustainability in the Qatar national dietary guidelines, among the first to incorporate sustainability principles. *Public Health Nutr* 18(13):2303-2310. Doi: 10.1017/S1368980014002110

Sustainable Development Commission (2009). Setting the table: advice to government on priority elements of sustainable diets. From: http://www.sd-commission.org.uk/publications.php@id=1033.html [Retrieved December 15 2020]

The Economist Intelligence Unit & Barilla Center for Food & Nutrition (2017). Food Sustainability Index 2017- Global Executive Summary. From: https://www.barillacfn.com/m/pdf/FoodSustainabilityIndex2017GlobalExecutiveSummarypdf [Retrieved September 21 2020]

Williamson D (2011). WWF-UK Livewell: healthy people, healthy planet. World Wide Fund, United Kingdom. From: http://assets.wwf.org.uk/downloads/livewell___healthy_people_healthy_planet.pdf [Retrieved August 16 2020]

Yong AG & Pearce S (2013). A beginner's guide to factor analysis: Focusing on exploratory factor analysis. *Tutor Quant Methods Psychol* 9(2):79-94.

Zulkefli N & Moy FM (2021). Development and validation of a Sustainable Diet Index among Malaysian adults: Protocol. *Sains Malays* 50(6):1697-1705. http://doi.org/10.17576/jsm-2021-5006-16