

Malaysian Healthy Diet Online Survey (MHDOS): Study rationale and methodology

Jyh Eiin Wong^{1,2}, Fui Chee Woon^{1,3}, Yit Siew Chin^{1,4}, Wai Siew Teh⁵, Rusidah Selamat⁵, Ahmad Ali Zainuddin⁶, Gilly A Hendrie⁷ & E Siong Tee^{1*}

¹Nutrition Society of Malaysia, Selangor, Malaysia; ²Centre for Community Health Studies (ReaCH), Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia; ³Department of Public Health Medicine, Faculty of Medicine and Health Sciences, Universiti Malaysia Sabah, Kota Kinabalu, Malaysia; ⁴Department of Nutrition, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, Selangor, Malaysia; ⁵Nutrition Division, Ministry of Health Malaysia, Putrajaya, Malaysia; ⁶Institute for Public Health, National Institute of Health, Ministry of Health Malaysia, Selangor, Malaysia; ⁷Health and Biosecurity, Commonwealth Scientific and Industrial Research Organisation (CSIRO), Adelaide, Australia

ABSTRACT

Introduction: Access to accurate and timely dietary information is of paramount importance in evaluating and developing well-targeted public health nutrition interventions. However, nationwide nutrition surveys are conducted infrequently because they are very costly to design, conduct and analyse. Dietary assessment tools, which are quick and cost-effective, are needed for population research and regular monitoring of Malaysians' dietary habits. This paper describes the rationale and methodology of the Malaysian Healthy Diet Online Survey (MHDOS) project, which aims to bridge this knowledge gap on dietary intake of Malaysian adults. The main objective of the two-year project is to develop MHDOS as a valid tool to measure compliance with the Malaysian Dietary Guidelines 2020. **Methods:** The MHDOS project has three study phases, namely (i) adaptation of an online survey and established diet quality scoring system for Malaysia, (ii) usability, validity and reliability testing of the online survey; and (iii) online survey administration in a nationwide study. The survey will be administered to approximately 10,000 Malaysian adults aged 18-59 years. **Discussion:** MHDOS consists of 38 questions that measure the quantity, quality and variety of foods consumed. Individuals will receive a diet quality score that reflects their overall compliance with the Malaysian Dietary Guidelines and feedback on how to improve their scores. The findings of the online survey, which serve to complement information between larger surveys, will be useful to measure compliance of Malaysians to national dietary guidelines and inform public health interventions.

Keywords: diet quality, dietary guidelines, online survey

*Corresponding author: Dr Tee E Siong
Nutrition Society of Malaysia, No. 27C, Jalan P.U. 7 (PJS 1/48), P.J. Selatan
46000 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: (6)019-3211788; Fax: (6)(03)77287426; E-mail: president@nutriweb.org.my
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INTRODUCTION

Access to timely and accurate dietary information is critical in evaluating and developing well-targeted public health nutrition interventions. Dietary information is important for the development and implementation of intervention programmes to improve dietary habits. Large-scale studies and national nutrition surveys have typically relied on traditional pen-and-paper methods such as 24-hour diet recalls, food records, and diet histories for dietary data collection. However, nationwide nutrition surveys are conducted infrequently because they are very costly to design, conduct and analyse (Micha *et al.*, 2018). In Malaysia, the last Malaysian Adult Nutrition Survey (MANS) was conducted in 2014 (IPH, 2014), ten years after the previous survey (IPH, 2008), which preclude timely reporting on the dietary status of the country. In addition, delays in making data available also hampers the timely implementation of appropriate nutrition intervention programmes.

Compared to comprehensive dietary assessment, brief tools that assess a targeted dietary habit or intake are more affordable and easier to administer, as they impose lower respondent and researcher burden in terms of data collection, processing and analysis. As adjunct measures, brief tools have high scalability and therefore can be administered at frequent intervals to measure and monitor adherence to or deviation from specific dietary patterns or dietary recommendations in public health settings (de Rijk *et al.*, 2021). Dietary assessment tools, which are quick, easy and cost-effective, are needed for population research and regular monitoring of Malaysians' dietary habits.

Online or web-based nutrition surveys are advantageous due to their

cost-effectiveness, enabling more frequent and greater geographical reach for dietary data collection than traditional methods (Amoutzopoulos *et al.*, 2018). Often in an online survey, brief tools, such as short food frequency questionnaires, are incorporated to self-report habitual intake across large numbers of individuals. Diet quality indices can then be applied to these data to summarise characteristics of dietary patterns into a single score, to indicate the degree to which individuals and/or populations' eating habits comply with a set of food-based dietary guidelines (Brassard *et al.*, 2022; Hlaing-Hlaing *et al.*, 2020). High diet quality, as assessed by valid diet quality indices, is associated with reduced risk of all-cause mortality and non-communicable diseases (Morze *et al.*, 2020).

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) Healthy Diet Score Survey is one of only a few scientifically developed and validated online dietary assessment tool that is freely available to the public, in this case the Australian public. The online survey questionnaire was developed to assess intake of five food groups, beverages, variety, healthy fats, and discretionary foods, allowing for compliance check with the Australian Dietary Guidelines (Hendrie *et al.*, 2017; Hendrie, Golley & Noakes, 2018). Individuals complete the survey online, and on completion are provided with an immediate and personalised Diet Score (i.e., a number out of 100 reflecting compliance with the Dietary Guidelines) and three suggestions on how to improve their scores. The diet score has been validated against 24-hour recalls in adults, and found to provide reliable and adequate estimate of overall diet quality in Australia (Hendrie, Rebuli & Golley, 2017).

The CSIRO Healthy Diet Score offers a contextually adaptable approach to collect dietary data in a Malaysian setting given the similarities in the structure of food-based dietary guidelines between Australia and Malaysia (NCCFN, 2021; NHMRC, 2013). A contextually specific and adapted version of the survey questions and scoring system would offer a useful population assessment and intervention tool. This paper describes the rationale and methodology of the Malaysian Healthy Diet Online Survey (MHDOS) project, which aims to bridge the knowledge gap on dietary intake of Malaysian adults.

Study rationale and objectives

Globally, the COVID-19 pandemic has drastically changed the diet and lifestyles of individuals (Naja & Hamadeh, 2020), with published evidence pointing toward increasing prevalence of suboptimal intake and wider disparity in diet quality between sociodemographic groups (Ong *et al.*, 2020). Several local studies which were conducted during the pandemic (between April 2020 – June 2021) reported positive changes in eating habits among young adults (Tan, Tan & Tan, 2022), government servants (Hamzaid *et al.*, 2022) and adults (Chin, Woon & Chan, 2022), despite some observed weight gain (Tan *et al.*, 2022) and reduced physical activity (Chin *et al.*, 2022) during the lockdown periods. However, it remains unknown whether these altered nutrition behaviours were transient or long-term after the pandemic crisis.

While it is important to rapidly and regularly assess the current dietary status of the population for nutrition surveillance, monitoring and prompt intervention, it is not feasible to roll out pen-and-paper-based large-scale dietary surveys within close time intervals due to time and resource constraints (Micha

et al., 2018). Recognising this dietary data gap, the Research Priority Area 2: National Food and Nutrition situation under the Nutrition Research Priorities in Malaysia for the 12th Malaysia Plan (2021-2025) has set ‘determine and monitor national food and nutrition situation regularly’ as one of its purposes. To achieve this purpose, development of feasible and reliable methods for population-based assessment of dietary intake is one of the suggested research topics (NCCFN, 2020). Meanwhile, the government has recognised that the COVID-19 pandemic has accelerated ‘new norm’ in the use and reliance of digital technology in daily life (Economic Planning Unit, 2021; Noraazwa, 2021). There is an increased need and unique opportunity to measure the dietary intake of the Malaysian population using an online survey tool.

An online survey tool, namely the Malaysian Healthy Diet Online Survey (MHDOS), can serve as a cost-effective complementary measure to assess current dietary habits of Malaysian adults. In addition, the survey will raise awareness of the advice provided in the Malaysian Dietary Guidelines 2020 (NCCFN, 2021) and inform strategies to change eating habits and improve diet quality.

Therefore, the main objective of the MHDOS project is to develop an online survey and scoring system to measure compliance with the Malaysian Dietary Guidelines. The developed online survey will be examined for its usability, validity and reliability before being rolled out to examine the diet quality of Malaysian adults.

MATERIALS AND METHODS

Study design

This is an observational, cross-sectional study which involves three main study

phases that are conducted between January 2022 and December 2023. They are (i) Phase 1: Adaptation of the CSIRO Healthy Diet Score scoring system to measure compliance with the Malaysian Dietary Guidelines; (ii) Phase 2: Usability, validity and reliability testing of the Malaysian Healthy Diet Online Survey (MHDOS); and (iii) Phase 3: Administrating the survey in a nationwide, full-scale study (Figure 1). The study protocol was reviewed and approved by the Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia (Ref: NMRR ID-22-00158-75G).

Phase 1 started in January 2022 and involved preparation of the online survey. As part of a collaborative research agreement established between

the Nutrition Society of Malaysia and CSIRO, the content of the survey was adapted from the CSIRO Healthy Diet Score survey and translated into three local languages. Using the Google Form, the usability of the online survey was tested in Phase 2 (Usability Testing) in May 2022. The online survey was disseminated through personal networks of the investigators and implied consent were taken from the participants.

Phase 2 Validity and Reliability Testing were conducted between June and October 2022. Participants were recruited from 13 states and three federal territories in Malaysia through convenience sampling by volunteer nutritionists from different states who underwent a short research training before recruitment. Written informed

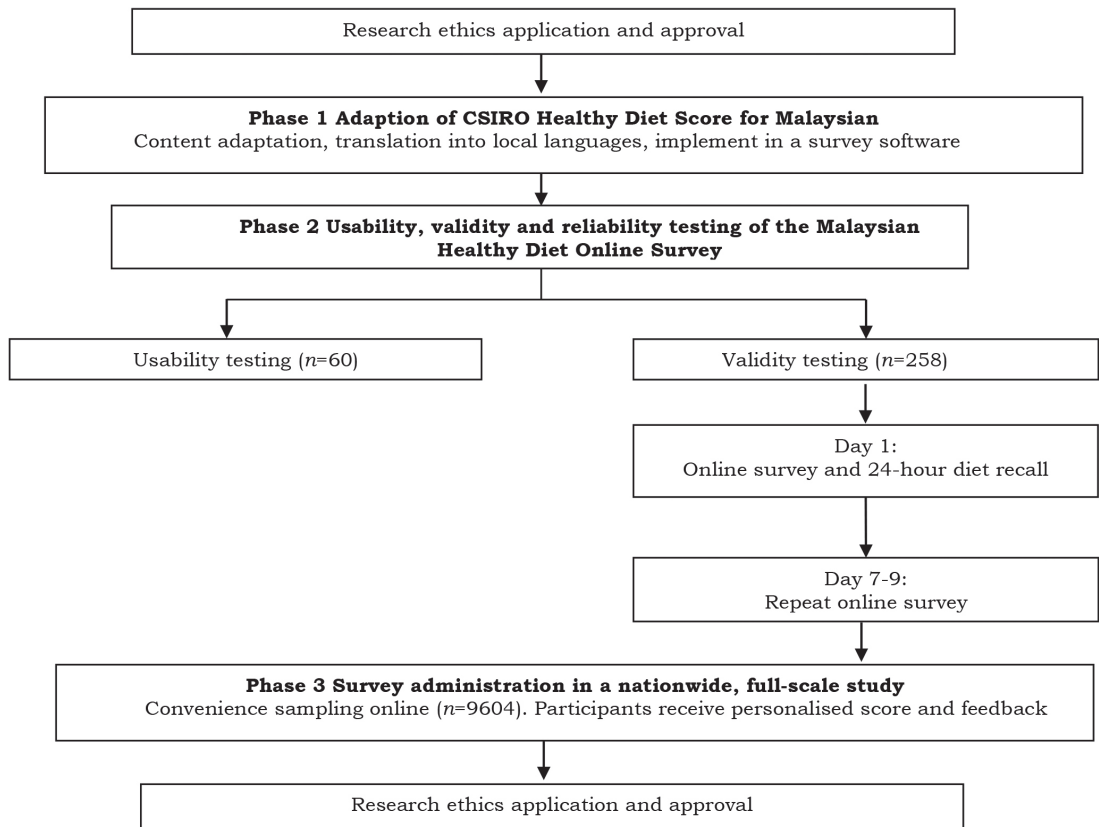


Figure 1. Flow chart of study methodology

consent were obtained from the participants prior to data collection.

Phase 3 Online Survey was conducted from December 2022 using the Alchemer (formerly known as SurveyGizmo) online survey platform. The online survey was launched through a social media campaign. On all study promotion posters and materials, there is a study link, on which interested participants could click to access the survey site. The participants are not required to sign into an account in order to fill in the survey. Implied consent is used in Phase 3 instead of written consent given the low risk involved in this study and the intent to communicate data at the population or group levels only.

Study population

This study involves Malaysian adults aged between 18-59 years, including men and non-pregnant or non-lactating women. The exclusion criteria are adults who are not able to respond to survey in either English, Malay, Mandarin, or Tamil language, not residing in Malaysia, and having dietary restrictions due to medical conditions.

Sample size estimation

For Phase 2 Usability Testing, a sample of 15 participants was deemed sufficient to uncover usability problems of a new survey, based on recommendation by Bastien (2010). Therefore, a total of 60 participants were recruited to test the usability of the four language versions of the survey. For assessment of validity and reliability, sample size was calculated assuming an expected small correlation between the online survey and reference method (ICC=0.20, 90% power). This study phase required a total of 258 participants to complete both methods of dietary assessment (Faul *et al.*, 2009).

For Phase 3 Online Survey, sample size was calculated based on a single

proportion formula for estimation of prevalence adjusted for finite population (Daniel & Cross, 2018). This phase requires a minimum of 9604 samples to have 95% confidence level of capturing real value within 0.01 margin of error.

Measures and procedures

Phase 1: Adaptation of the CSIRO Healthy Diet Score for Malaysia

Phase 1 aims to adapt, translate and evaluate the content validity of the Malaysian Healthy Diet Online Survey (MHDOS). The content of the original CSIRO Healthy Diet Score survey was adapted (with permission) so that the food items reflected the local diets and the modified scoring system reflected the Malaysian Dietary Guidelines 2020 recommendations (NCCFN, 2021). Content validation and adaptation were conducted by a panel of experts in the field of nutrition. The English beta version of the adapted survey was forward-backward translated into three local languages, namely Malay, Mandarin and Tamil languages. Firstly, the English version of the adapted survey was translated into the target language by three independent translators who were native speakers of the target language, proficient in English, and with an educational background in nutrition. The translated survey was then back-translated into English by another three independent translators who were proficient in English and their native languages. The original and the back-translated surveys were reviewed by the research team to determine their consistency. The survey was transformed into a consumer grade survey using the online survey platform Alchemer (formerly Survey Gizmo, Louisville, CO, USA), hosted on a dedicated cloud server. The survey system provides end-to-end data encryption and is EU General Data Protection Regulation (GDPR) compliant (Alchemer, 2022).

Phase 2: Usability, validity and reliability testing of the Malaysian Healthy Diet Online Survey (MHDOS)

The main aim of Phase 2 is to establish the adapted survey as a valid brief dietary assessment tool for the Malaysian population.

Usability testing

The usability of the survey (for each language version) was examined using the System Usability Scale (Brooke, 1996). Participants were required to complete a 10-item questionnaire in rating their agreement with the statements that measure the perceived ease-of-use of MHDOS on a five-point Likert-scale, ranging from “0 - Strongly Disagree” to “4 - Strongly Agree”. To calculate the total score, the first step was to subtract 1 from the score for each of the odd numbered (positively-worded) questions and subtract the score from 5 for each of the even numbered (negatively-worded) questions. The calculated scores for each question were summed and multiplied by 2.5 to obtain a total score ranging from 0 (very poor) to 100 (excellent perceived usability). A total score above 68 was considered as above average (Sauro & Lewis, 2016). Meanwhile, the participants were asked to provide feedback on their impression of the survey in terms of clarity of words, understanding of the terms, relevance of the items, flow of the questions, and length of the survey. Generated user feedback was incorporated iteratively in the revision of the survey tool.

Validity and reliability testing

MHDOS was evaluated for test-retest reliability and relative validity. Volunteer nutritionists from different states underwent a short research training before recruitment of participants. First, participants were invited to complete the self-administered MHDOS, followed

by a multiple-pass, single 24-hour diet recall interview (as a reference method) to determine their usual food intakes for comparison with the data from MHDOS. Next, participants were reminded to complete the online survey for the second time within a two-week period. Participants who withdrew from the validity and reliability testing after the two-week interval were replaced until the required sample size was achieved.

Phase 3: Survey administration in a nationwide, full-scale study

Phase 3 aims to determine the overall diet quality of Malaysian adults and assess their compliance with the Malaysian Dietary Guidelines 2020 by using the validated MHDOS. At the beginning of the online survey, participants are presented with the study information, followed by an implied consent form. If they choose to proceed, they will be directed to answer 38 questions about their usual intake in terms of frequency (per day, week or month) and quantity (servings) for five core food groups, namely (i) vegetables; (ii) fruits; (iii) rice, other cereals, whole grain cereal-based products and tubers; (iv) fish, poultry, eggs, meat and legumes; and (v) milk and milk products. Digital portion size images will be provided to assist estimation of portion sizes. In addition, participants will be asked on their habitual intake of beverages and discretionary foods, food choices (i.e., consumption of wholegrains, types of milk, types of fat and oil consumed, trimming of fat, and water consumption), and variety of foods consumed within each core food group. The amount of core and discretionary foods consumed daily are then compared to recommended servings in the Malaysian Dietary Guidelines 2020 according to sex and physical activity levels. A nine-component diet quality score will be derived from the MHDOS.

Each of the nine components of the total diet quality score is calculated as a sub-score out of 10, except for one component (i.e., discretionary foods), which is scored out of 20. Scores range from zero to 10 for each component and 20 for discretionary foods, where a higher score reflects greater compliance with recommendations for the food group. The scores for each component are then summed to give a total diet quality score out of 100. The higher the score, the closer participants are to meeting the recommendations of the Malaysian Dietary Guidelines 2020.

The participants will also provide sociodemographic information on their sex (gender), year of birth, state of residence, ethnicity, education level, occupation, self-reported body weight and height, and lifestyle factors including physical activity level. Following completion of the survey, participants will receive their calculated diet quality score (range from 0 to 100), which reflects their compliance with the Malaysian Dietary Guidelines, as well as suggestions on how to improve their scores for each component.

Statistical analysis plan

Statistical analysis is carried out by using IBM SPSS Statistics for Windows version 25.0 (IBM Corp, Armonk, New York). Descriptive analysis will be presented as mean and standard deviation (*SD*) for continuous variables, whilst categorical variables will be presented as frequency and percentages (%).

For Phase 2 of the study, dietary data from the 24-hour diet recalls are analysed using the Nutritionist Pro™ software version 5.3.0 (Axxya System, Washington, USA) for conversion into energy and nutrient intakes. Test-retest reliability of the MHDOS is tested using Pearson's correlation and intra-class correlation (*ICC*) coefficients. As for

relative validity, paired-sample t-test is carried out to determine the mean differences in the reported food group intakes, while Pearson's correlation coefficients are used to assess the strength of relationships between the first administration of MHDOS and 24-hour diet recalls. In addition, the derived diet quality score from MHDOS is examined on its association with nutrient profiles from 24-hour diet recalls to establish the construct validity of MHDOS. Bland-Altman plots is used to analyse the mean bias and 95% limits of agreement between the two methods in deriving the diet quality scores.

For Phase 3 of the study, Pearson's correlation will be used to determine the associations between continuous variables, while independent samples t-test and one-way analysis of variance (ANOVA) will be used to compare the mean diet quality score between groups. A multivariable linear mixed model will be used to determine the associations of sociodemographic characteristics and lifestyle factors with each component of the diet quality score, as well as the total score. Sociodemographic characteristics and lifestyle factors will be entered as fixed effect, while state of residence will be entered as random effect using the variance component covariance matrix. The statistical significance will be set at $p < 0.05$.

DISCUSSION

This paper describes the rationale and methodology of the MHDOS project, which aims to develop a valid online dietary assessment tool to measure diet quality of Malaysian adults. This is a multi-stakeholder collaborative project by the Nutrition Society of Malaysia, Ministry of Health Malaysia and CSIRO. This project is motivated by the need for a reliable and cost-effective

complementary tool to facilitate periodic collection of reliable dietary data in a Malaysian adult population setting.

Large-scale studies and national nutrition surveys in Malaysia are subject to interview-administered or paper-and-pen methods such as 24-hour diet recalls and food frequency questionnaires for dietary data collection (IPH, 2014; Poh *et al.*, 2013). While these methods are invaluable in providing in-depth and high-quality information on dietary intake, they are labour- and resource-intensive in collection, processing and analysis. The complexity and burden associated with these methods ultimately limit the capacity of population-based dietary surveys to provide timely and up-to-date dietary data. New technology or digital-based dietary tools, such as online surveys and mobile applications, provide viable alternatives to address some of the limitations inherent in conventional dietary assessment methods (Bell *et al.*, 2017; Cade, 2017). While MHDOS is not a 'high end' innovation, the online survey represents a large improvement on what is currently practised in terms of ease and efficiency of dietary data collection and processing.

The MHDOS is a newly developed online dietary assessment tool that was adapted from the CSIRO Healthy Diet Score survey (Hendrie *et al.*, 2017). It was tested for its validity as a dietary assessment tool before being rolled out as a full-scale nationwide survey. MHDOS assesses the quantity, quality, and variety of foods consumed by individuals and includes coloured images of foods to facilitate the estimation of portion size. Being accessible on desktop and mobile devices, researchers can collect real-time dietary data from large samples regardless of time and geographical location with lower costs and burden. For instance, the CSIRO Healthy Diet Score survey has successfully captured data from over 230,000 Australians

since it was launched in 2015 (Hendrie *et al.*, 2021). Another valuable feature of the MHDOS, is the potential to generate a score that reflects individuals' overall compliance with the Malaysian Dietary Guidelines 2020, as well as provide individual feedback on how to improve their diet quality. While this process is currently manual, it is possible to integrate an automated reporting system in the future, which can provide personalised feedback in real time upon completion of the survey.

The MHDOS has the potential to serve as a complementary survey tool to collect individual-level dietary data in a cost-effective, accurate and timely manner. The data generated from the survey enhance the monitoring of dietary intakes and measure the degree of adherence to the national dietary guidelines (NCCFN, 2021). Meanwhile, the data can be used to identify the disparities in diet quality among different socioeconomic groups and ascertain population groups who might be at nutritional risk due to inadequate or excessive intake of specific food groups. This information can be furnished periodically to assist healthcare professionals and policy makers in designing and implementing appropriate nutrition intervention programmes to improve the overall diet quality of the Malaysian population. When the online survey is administered over time, the data can discern temporal and spatial changes in dietary patterns of Malaysian adults. This information will be useful to monitor and evaluate the impact of implemented nutrition policies, interventions and programmes.

A number of main limitations need to be considered regarding the design of the MHDOS project. First, this study is subject to selection bias due to the use of convenience sampling. While conscious effort will be made to encourage inclusive participation from different sex, ethnicity and states, it is likely that participants

who volunteered in the study are those who are health-conscious or digitally savvy, while disadvantaged populations may be under-covered. Second, we acknowledge that the usefulness of MHDOS, like all other online survey tools, is constrained by illiteracy, limited internet connectivity, and access to computers. Internet availability, accessibility and affordability remains a concern among adults in low-resource urban settings, despite their reception to technology adoption (Lim *et al.*, 2022). Nonetheless, with the improving trend in digital literacy and commitment for ubiquitous and low-cost internet access (Economic Planning Unit, 2021), MHDOS will prevail as a promising alternative population-based tool for dietary assessment. Finally, besides establishing the validity and roll out of the survey, it is also crucial to ensure the sustainability of the MHDOS beyond the project timeline. There is a need to secure survey funding through public-private partnerships, sponsors or other options to ensure streamlining or effective continuity of the survey in the long term.

CONCLUSION

We envisage that the Malaysian Healthy Diet Online Survey will be useful to provide insights about the population's dietary intake between larger national surveys. In addition to providing timely evidence on compliance to the new national dietary guidelines, the survey will also help to inform public health strategies and intervention to improve the diets of Malaysians.

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Authors' contributions

Wong JE, Chin YS, Tee ES and Hendrie GA conceptualised and designed the study; Woon FC, Teh WS, Rusidah S, and Ahmad Ali Z provided research training and/or coordinated data collection; Wong JE prepared the first draft of the manuscript and all co-authors revised the manuscript for important intellectual content. All authors approved the final version of the manuscript to be published.

Conflict of interest

The authors declare no conflict of interest.

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