

METHODOLOGY OF ADOLESCENT NUTRITION SURVEY IN MALAYSIA 2017

Norazizah Ibrahim Wong¹, Mohd Azahadi Omar¹, Ruhaya Salleh²,
Muhammad Fadhli Mohd Yusoff², Tahir Aris³

¹Sector for Biostatistics & Data Repository, National Institutes of Health Ministry of Health Malaysia

²Institute for Public Health, National Institutes of Health Ministry of Health Malaysia

³Institute for Medical Research, National Institutes of Health Ministry of Health Malaysia

Corresponding author: Norazizah Ibrahim Wong, Email: norazizah.wong@moh.gov.my

ABSTRACT

Background: The Adolescent Nutrition Survey (ANS) 2017 was a second nationwide nutrition school-based health survey in Malaysia covering students aged 10 years to 17 years (Standard 4 - Form 5), who attended schools during data collection. It aims to provide data on nutrition-related issues of adolescents in Malaysia. This paper will describe the methodology of ANS 2017.

Materials and Methods: This is a cross-sectional survey with multi-stage stratified cluster sampling design. The sampling frame involved all schools containing any of Standard 4 until Form 5, which were selected randomly using probability proportional to school enrolment size. The sampling was continued by a randomly selection of classes from each selected school. Within the classes, all students were included in the study. A selection of students from each selected class was done as the third stage of sampling. Data was collected via questionnaire (self-administered and face-to-face interview) and physical examination.

Result: A total of 311 schools including 212 secondary schools and 99 primary schools were involved in this survey. Of the 44,773 students eligible for this study, 40,087 students were completed the questionnaires with response rate at 89.5%.

Conclusion: The robust methodology used in ANS provides a valid and reliable national estimate for nutritional-related issues among Malaysian adolescents.

Keywords: Adolescent Nutrition Survey, Methodology, Dietary Intake, Malaysia

1.0 Introduction

World Health Organization (WHO) defined adolescents as the transitional period which occurs after childhood and before adulthood between the aged of 10 to 19 years old. During this period, the human growth and development rapidly occurred (WHO, 2017). This is an important period in human development to achieve full growth potential and to reduce the risk of chronic diseases in adulthood (Virginia & Ann, 2007).

Worldwide, studies have highlighted the rising prevalence of overweight among children or adolescents which significantly impact the economic cost (Wang & Dietz, 2002). Furthermore, many previous studies have shown the association between childhood obesity and the risk of developing Type 2 diabetes and cardiovascular diseases (Sahoo, et.al, 2015, Freedman, et.al 1999, American Diabetes Association, 2016). In Malaysia, the national health and morbidity study conducted since 1986 until 2015, showed an alarming trend of the increasing prevalence of non-communicable diseases including hypertension, diabetes mellitus and its risk factors such as obesity, hypercholesterolaemia, smoking habit, physical inactivity and poor dietary habit among Malaysian adults. The Global School Based Health Survey (GSHS) 2012 in Malaysia showed that 22.8% of adolescents were overweight while 9.5% were obese (Institute for Public Health (IPH), 2012). Due to this alarming trend, it is important to detect the risk factors earlier, i.e. during childhood and adolescent period, for early intervention and prevention of the chronic diseases.

Generally, adolescents living in developing countries facing a chronic malnutrition problem (WHO, 2006). A severe malnutrition suffered during childhood causing an important action to be taken to ensure an adequate nutrition intake among adolescents. A poor nutritional status among child and adolescents showed an increasing risk of various chronic diseases during adulthood (Case et.al, 2005). A goal to “eradicate extreme poverty and hunger” in the first Millennium Development, the underweight prevalence in developing regions for children was forecasted to decline 10.9% to 19.3% during 1990 to 2015 period (De Onis et.al, 2004). The decreasing pattern of undernutrition rate was also shown among the Malaysian children. Result from the National Health and Morbidity Survey (NHMS) 2015 showed a decreasing malnutrition trend among the children below 18 years old with 13.0% of underweight, 13.4% stunting and 7.8% thinness as compared to NHMS 2006 (Institute for Public Health (IPH), 2008, Institute for Public Health (IPH), 2015). The behavioural factors related to childhood obesity were identified as high-calorie intake and sedentary lifestyle. A various medical chronic condition in adulthood were associated by the obesity status during childhood and adolescent, therefore an appropriate action should be given as a high priority (Sahoo, et.al, 2015).

Nowadays, tablet-based data collection was identified as a good tool to shorten the duration of data processing. Tablet-based data collection is the more cost-effective method, had less errors and faster data entry (David Wogan. 2014). Previously, for module habitual food intake (FFQ) in Malaysia School-based Nutrition Survey (MSNS) 2012, data collection was carried out using paper-based method. For module FFQ in Adolescent Nutrition Survey (ANS) 2017, mobile device was used as data collection method which had been proven can be shorten the duration of data processing, since the data can be obtained directly from server. In addition, certain rules for quality control were developed in the application to ensure a clean data obtained faster as well as to help reduce errors as compared to a paper-based method (ICAP, 2015).

The ANS 2017 is the second nationwide nutrition school-based health survey conducted nationally in Malaysia. GSHS was the first survey conducted in 2012 and has collaborated with the WHO. The adolescent's school-based population survey has provided the baseline health-related conditions and behaviours among adolescents in Malaysia. Those data-driven evidences have enabled the programme managers to assess the effectiveness of the implemented strategies at the school and the community levels. Therefore, developing a quality and replicable research methodology would enhance the quality of evidence and promote advancement of research methodology in future research. Thus, this paper will describe the methodology of ANS 2017.

2.0 Materials and Methods

2.1 Scope of the study

This study focused on nutrition-related components including dietary intake, meal pattern, habitual food and supplement intake, nutritional status, behaviour modification, physical activity as well as basic sociodemographic characteristics.

2.2 Study design and sampling frame

To represent national school-going adolescents aged 10 to 17 years old, this survey was conducted as a cross-sectional study. A sampling frame was obtained from the Ministry of Education and Ministry of Rural and Regional Development containing a list of primary and secondary school. Students' enrolment data for standard 4 until standard 6 (primary school) from 7,925 primary schools and from 2,738 secondary schools for form 1 to form 5 (secondary school) in 2016 were used.

2.3 Sample size

This survey using a single proportion formula to calculate the sample size. The calculation was taking into account all the expected prevalence of the target variables, confidence intervals of 95% and the desired margin of error (e) of between 0.01 to 0.05. Sample size was calculated for each of the proposed objectives based on the previous MSNS 2012 data. The largest sample size calculated was selected to ensure enough samples for each of the objective.

$$n_{SRS} \geq \frac{z_{\alpha/2}^2 P(1-P)}{e^2}$$

To ensure optimum sample size, the $n(srs)$ was adjusted to the total number of target students based on 2016 enrolment data with design effect of 2.0 and an expected non-response rate of 25%. A total of 44,496 adolescents were required to involve in this study of which 2,781 adolescents had been selected from selected schools in each state. For the additional Nutrition Survey submodule, a total of 1,422 adolescents were enrolled for the 24-hours dietary recall submodule and 2,096 adolescents were required for the food frequency intake submodule.

2.4 Sampling design

A multi-stage stratified cluster sampling was used to ensure national students' representativeness (Wiegand, 1968). During the proses of sampling, the stratum consisted of all the 16 states including three Federal Territories in Malaysia. A systematic sampling with a random start was used in the selection of schools and classes. Primary schools consist of Standard 4 to Standard 6 students and Secondary schools containing any of Form 1 until Form 5 students were involved in the first stage of sampling. A total of 311 schools including 212 secondary schools and 99 primary schools were selected randomly to involve in this survey using a probability proportional to school enrolment size.

The second stage of sampling involved all classes within the selected schools. The numbers of classes selected from each school were based on the student enrolment. A systematic sampling technique was used in the selection of classes from each selected school. All students from the selected classes were then engaged for the survey.

Table 3.1. Distribution of Secondary Schools Sampled by State.

State	Total Number of Schools	Number of Schools Sampled	Number of Classes Selected	Number of Eligible Enrolments
Johor	306	14	69	1915
Kedah	219	14	68	1930
Kelantan	193	14	78	1900
Melaka	87	14	73	1986
N. Sembilan	139	14	69	1930
Pahang	209	14	81	1948
P. Pinang	141	14	72	1974
Perak	275	14	79	1931
Perlis	33	14	85	1992
Selangor	345	14	59	1840
Terengganu	162	14	80	1880
Sabah	246	14	62	1965
Sarawak	220	14	63	1919
W.P. Kuala Lumpur	133	14	67	1937
W.P. Labuan	19	8	78	1907
W.P. Putrajaya	11	8	77	1869
Malaysia	2,738	212	1,160	30,823

For this survey, 14 secondary schools were selected at each state and eight schools were selected at the Federal Territory of Putrajaya and Labuan (Table 3.1).

Table 3.2. Distribution of Primary Schools Sampled by State.

State	Total Number of Schools	Number of Schools Sampled	Number of Classes Selected	Number of Eligible Enrolments
Johor	921	6	31	914
Kedah	552	6	29	860
Kelantan	423	6	34	876
Melaka	236	6	34	876
N. Sembilan	352	6	31	893
Pahang	543	6	33	874
P. Pinang	275	6	32	872
Perak	852	6	34	901
Perlis	73	6	32	877
Selangor	727	6	26	881
Terengganu	354	6	31	858
Sabah	1090	8	30	890
Sarawak	1274	7	28	872
W.P. Kuala Lumpur	227	6	25	762
W.P. Labuan	12	6	32	882
W.P. Putrajaya	14	6	27	862
Malaysia	7,925	99	489	13,950

To complete the coverage, six primary schools were selected at each state in Peninsular Malaysia, eight for Sabah and seven for Sarawak (Table 3.2). The third stage of sampling was applied for the additional nutrition sub modules i.e. 24-hours dietary recall and food frequency intake. Students from the selected classes were then selected and recruited for this sub modules survey.

2.5 Study tools

2.5.1 Questionnaires

Based on the scopes of the survey, a structured questionnaire was used to collect data. The Malaysian MSNS 2012 questionnaires was used as a based (Yusoff et.al, 2012). The WHO and Centers for Disease Control and Prevention (CDC) of the United States as well as United Nations Children's Fund (UNICEF), the United Nations Educational, Scientific, and Cultural Organization (UNESCO) were the responsible organisation in developing the original questionnaire. It has been widely used by more than 100 countries worldwide and enables an international comparison. The questionnaires were prepared in bi-lingual (Malay and English) accompanied its manual as a guide to the data collectors. The questionnaires were then pre-tested at the field. The modified and finalized questionnaires by the Review Committee were then used for full survey implementation. The questionnaire consisted of 7 modules:

- a) Meal pattern module; respondents were asked 28 questions on their usual daily and weekly meal pattern.
- b) Physical activity module; The physical activity Questionnaire for Older Children (PAQC) was adapted from Kowalski et al (2004) to assess the general level of physical activity of the adolescents.
- c) Behaviour modification module: This module consisted of six questions on self-perception of body weight behaviour associated with body weight perception.
- d) Supplement intakes module; consisted of eight questions on supplements intake (vitamin/mineral and dietary supplement) by the respondents.
- e) Nutrition and food labelling module; This module consisted of 10 questions on nutrition and food labelling
- f) 24-hours dietary recall: This questionnaire was used to record the quantity of every food item or drink consumed by the respondents on the previous day of the survey. This survey was conducted by a nutritionist. The 24-hour intake of calories, fat, protein, carbohydrates, specific vitamins and minerals were calculated by using the Nutritionist Pro (AxxxA Systems, Stafford, TX) software.
- g) Food frequency module: This survey was conducted as a face-to-face interview using mobile data collection devices. Respondents were asked on their usual pattern of food consumption and were recorded in various classes such as milk, fish, eggs, meat, cereals, legumes, fruits and vegetables, fats, oil, and others (132 items). The responses recorded were according to the daily and/or weekly basis and/or monthly frequency of food intake and size of each item consumed.

2.5.2 Anthropometry Measurement

Anthropometry measurements are part of nutritional status components to assess body size and composition; and reflect adequate, inadequate or excessive food intake. Body weight were measured using a digital weighing scale with an accuracy of 0.1 kg (TANITA HD-319), with the adolescents wearing school uniforms without shoes, socks, or belts. Height was measured using Seca 206 Bodymeter to the nearest 0.1 cm. Each measurement was obtained twice, and the average was recorded as the final reading. The nutritional of adolescents was identified based on WHO Growth Reference 2007. The major indices referred to were Height-for-Age z-score and BMI-for-Age z-score.

2.6 Data collection

After approval from the Medical Research Ethics Committee (MREC), Ministry of Health and Educational Planning and Research Division, Ministry of Education were achieved, further approval from the Department of Education at each federal, state, and district was pursued before the data collection was conducted. This nationwide school-based survey took six weeks to be completed. Thirty-six data collection teams were formed; four teams for each for Sabah and Sarawak; and two teams at the remaining states. Each team consisted of one team leader, one nutritionist, and three research assistants. A field supervisor was assigned for each state to supervise the survey activities at the appointed state. A central team was formed to oversee the overall conduct of the survey. All data collectors were specifically trained for the survey before the field implementation.

Prior to the data collection, the person-in-charge at each school was contacted. Approval to conduct the survey at the selected school was obtained from the school's highest authority. The person-in-charge be responsible to distribute the Parental and students consent forms. Prior to the survey, the parental and students consents forms were collected. Students who have agreed to participate in the survey have gathered at the location provided at the school. Each respondent was given an Optical Mark Reader (OMR) form together with a questionnaire booklet, pencil, eraser and envelope. To maintain the confidentiality, the respondents were required to insert the answered OMR form in the envelope. The reading of anthropometry measurement conducted by data collectors was also filled in the OMR form by the student.

For submodule habitual food intake (FFQ), the data collection was done using e-NHMS 2017 application, contained all the questions that were required in the face-to-face interview. As many as 90 tablets were used for NHMS 2017 survey. Each team was given 2 tablets for data collection. Each data collector was provided a manual about tablet usage and care, as well as the IKU SCS (Data collection system) application user's guide. As the data collected in the field were directly submitted to the server, certain rules for quality control were developed in the applications.

2.7 Quality control and data entry

In this survey, data quality check was performed in two phases. Phase 1 quality control was conducted at the field. The Field Supervisor was required to review all filled OMR forms and questionnaires at the end of each day of the data collection. The second phase of the data quality check was performed at the data operation centre, Institute for Public Health. This was conducted once the bundles of the filled OMR forms and cover forms arrived at the Station 1 of the operation centre. The schools' ID, class ID and students' ID were examined and compared with the original lists. Any discrepancy was referred back to the team leader or field supervisor. The checked OMR forms were then transferred to Station 2 for scanning. The data captured by the scanner was verified with the hardcopy OMR forms by the verifiers before exported to the database server. For the dietary intake submodule, data was entered into special software i.e. the Nutritionist Pro software before the data was converted into Excel database.

2.8 Data Analysis

Data analysis was done using IBM SPSS Statistics for Windows, Version 21.0. (IBM Corp; Armonk, NY: 2012) by importing the raw dataset which normally in CSV form or excel. The data set was checked, cleaned and edited for inconsistencies. The analysis was done according to the objectives, working definition and dummy tables prepared by each research group. Complex samples analysis procedures were used in the analysis and was carried out at 95% confidence interval. The sample weight was calculated which associated with the likelihood of being sampled and compensating for differing patterns of nonresponse. The weight (W) used for estimation was given as follows:

$$W = W1 \times W2 \times W3 \times F \times PS$$

where W1 is the inverse of the probability of selection for each sampled school, W2 the inverse of the probability of selection for each classroom in each of the sampled schools, W3 the inverse of the probability of selection each student in each of the sampled class, F the inverse of a

school, class and student level non-response adjustment and PS a post stratification adjustment factor calculated by class and gender. In general, the weight of a sampled unit is the reciprocal of its probability of selection into the sample.

3.0 Result

Table 3.1: Comparison between ANS 2017 respondents and national enrolment of school students in Malaysia 2017

State	ANS 2017 respondents			National Enrolment 2017	
	Unweighted count	Estimated Enrolment (weighted)	Percentage (%)	Secondary School Students	Percentage (%)
Malaysia	40,087	3,480,500	100.0	3,480,439	100.0
State					
Johor	2,565	439,369	12.6	439,406	12.6
Kedah	2,490	250,426	7.2	250,388	7.2
Kelantan	2,464	207,201	6.0	207,206	6.0
Melaka	2,685	106,254	3.1	106,253	3.1
Negeri Sembilan	2,431	139,235	4.0	139,242	4.0
Pahang	2,563	174,713	5.0	174,721	5.0
Pulau Pinang	2,547	178,446	5.1	178,453	5.1
Perak	2,527	281,354	8.1	281,352	8.1
Perlis	2,496	38,004	1.1	37,999	1.1
Selangor	2,503	651,976	18.7	651,925	18.7
Terengganu	2,437	158,658	4.6	158,645	4.6
Sabah	2,437	331,295	9.5	331,298	9.5
Sarawak	2,534	321,046	9.2	321,063	9.2
WP Kuala Lumpur	2,410	177,937	5.1	177,902	5.1
WP Labuan	2,525	9,604	0.3	9,602	0.3
WP Putrajaya	2,473	14,982	0.4	14,984	0.4
Sex					
Male	19,677	1,746,339	50.2	1,746,326	50.2
Female	20,410	1,734,161	49.8	1,734,113	49.8
Form					
Standard 4	4,617	448,352	12.9	448,329	12.9
Standard 5	4,205	442,371	12.7	442,339	12.7
Standard 6	3,777	443,262	12.7	443,262	12.7
Form 1	5,702	450,996	13.0	451,024	13.0
Form 2	5,499	426,921	12.3	426,908	12.3

Form 3	5,834	431,004	12.4	431,043	12.4
Form 4	5,536	414,703	11.9	414,653	11.9
Form 5	4,917	422,891	12.2	422,881	12.2

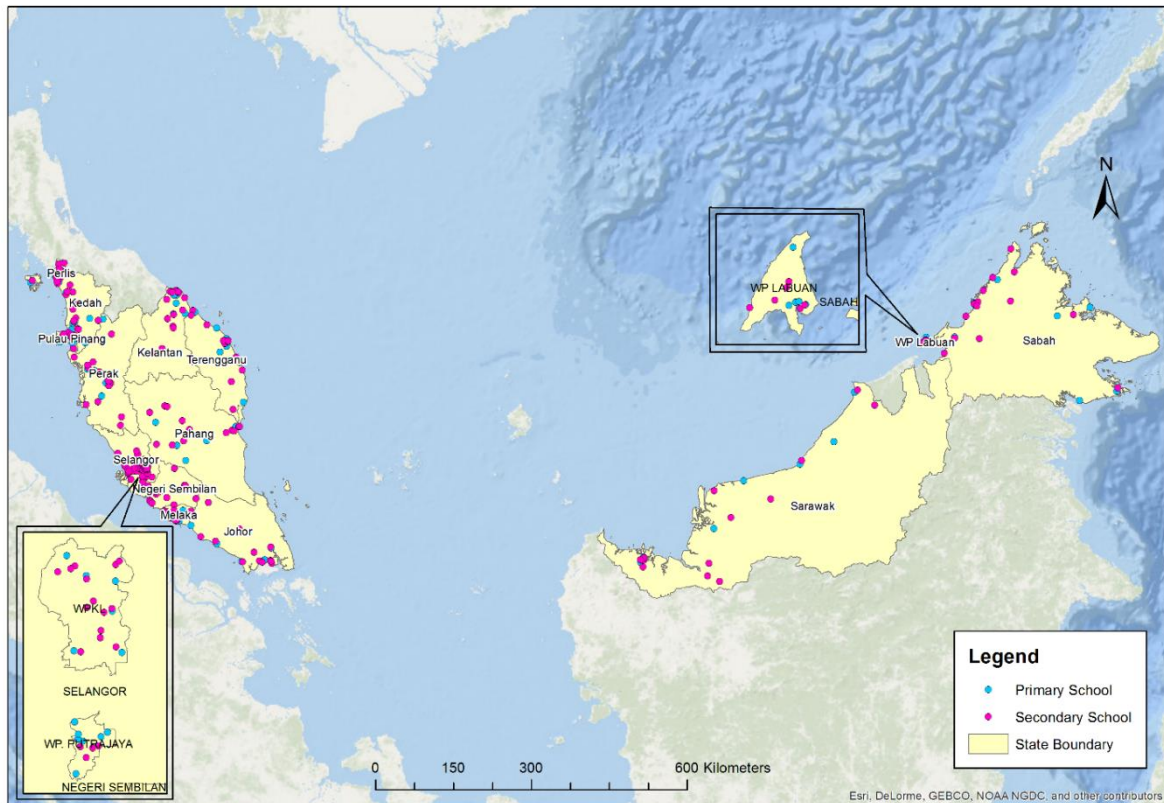


Figure 3.1: GIS mapping of the selected primary and secondary schools for ANS 2017

A total of 40,087 questionnaires for adolescent nutrition survey, 2,021 Habitual Food Intake and 1,374 for dietary intake were completed by the respondents. The school and class response rate were 100% respectively, while the student response rate for adolescent nutrition survey was 89.5%. Meanwhile, the response rate for the Habitual Food intake module and Dietary Intake were 96.4% and 96.6% respectively. A comparison of population estimation of ANS with the national school enrolment is shown in Table 3.1. Geographic information system (GIS) on the mapping of selected primary and secondary schools is shown in Figure 3.1.

4.0 Discussion

The methodology is crucial for any successful survey. Hence, a robust methodology was utilized in implementing this survey to ensure the representativeness of the study and reliable findings for policy makers. The sample size was calculated using an appropriate formula with taking into account a few criteria and adjustments as well as a good or acceptable precision to estimate the adolescent population prevalence of the health conditions specified in this survey

(Institute for Public Health (IPH), 2012, Yusoff et.al, 2014, Naing, 2006). To ensure that all students in the schools have the same probability of selection irrespective of the size of their cluster, each of the hierarchical levels prior to the ultimate level has to be sampled according to the size of ultimate units it contains, but the same number of units has to be sampled from each cluster at the last hierarchical level (WHO, 2016).

The ANS also used a validated and standardized questionnaire consisting of core questionnaire modules, which is in line with practices by all countries participating in the GSHS (WHO & CDC, 2013). The process of development of this tool involved several workshops attended by experts from the Ministry of Health, Malaysia and the WHO representative for technical support within the year of 2011 to 2012 (Institute for Public Health (IPH), 2012). With the increasing trend of non-communicable disease risk factors and nutritional status, it is the right time to have a similar survey in 2017 specially to monitor health status of adolescents in the country. Thus, to continue exploring issues pertaining to nutrition related component in adolescents in Malaysia such as dietary intake, habitual food intake, meal pattern, vitamin/mineral and food supplement intake, nutritional status, food and nutrition labelling, body weight perception and physical activity level, the validated questionnaire and measurement tool are very crucial in this study.

The use of tablets in data collection especially for habitual food intake has shortened the duration of data processing. An accurate data collection is essential to maintain the integrity of the research data (Northern Illinois University, 2003-2004). Survey response error at minimum level and data were directly transferred to server right after questionnaire were completely answered were the advantages of using mobile device as a data entry medium.

A weighting factor was applied to each student record to adjust for non-response and for the varying probabilities of selection. Finally, the data is representative of all students attending school from Standard 4 to Form 5 in Malaysia. In line with a proper methodology and successful implementation, the data on the nutrition status of the adolescents will be used to support Ministry of Health in strengthening the adolescent health programme. This study should complement population-based data gaps on nutritional issues in the country and strengthening the adolescent nutrition programme.

In conducting a nation-wide study among adolescents in Malaysia like ANS 2017, a good collaboration and support from relevant agencies and department is very crucial. The sampling frame was provided by the Ministry of Education and Ministry of Rural and Regional Development. A good cooperation and support were also given by the Department of Education at each federal, state, and district, especially during the field works. An inter-ministry collaboration for gathering data among adolescents was the best strategy for this survey. It's also more valuable if preventive programs taking place in schools after this survey. Although ANS 2017 was designed to sample adolescent all over the country, some schools with P3 category were still excluded from the sampling frame. This was mainly due to logistic reasons as these schools were located on an island, without the availability of land transportation to go to the nearest town and, only sea/water transportation method is available. In spite of these limitations, the design of ANS 2017 is generally effective.

5.0 Conclusion and recommendation

In conclusion, ANS 2017 has adopted an appropriate methodology for an adolescent survey. To ensure retrieval of valid and quality data, a good planning of the survey have been taken as well as determining the sample size, sampling design, questionnaires validation, training of enumerators, data collection techniques and data processing (including quality assurance, data cleaning and analysis). Furthermore, ANS 2017 successfully produced data with adequate precision to meet the requirements of the objectives. It shows a possible relationship between health and nutritional variables among adolescents in Malaysia. The data on the nutrition and health status of adolescents in Malaysia will be used toward strengthening the adolescent nutrition and health program in the country, this scenario was also implemented in all other countries participating in the GSHS as well as in “Health Behavior in School-aged Children” (HBSC) study.

Acknowledgement

Ethical approvals for the study were obtained from the Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia. This study was also approved by the Ministry of Education Ethics Committee. Approval was also obtained from the relevant Ministry of Education officials at the state and district levels including the selected school itself. Consent form for participation in the survey were obtained from parents and the students involved.

The author(s) would like to express our gratitude to the Director General of Health Malaysia for the permission to publish this article. We also would like to thank National Health and Morbidity Survey (NHMS) Steering Committee Team for supporting this research and to those who involved in this research team as well as the student who joined the survey. Special thanks to Director General of Education, Ministry of Education Malaysia for providing the sampling frame and permission to conduct the survey in schools.

Declaration

Author(s) declare that no potential conflict of interest to the publication of this article.

Authors contribution

Author 1: conceived the idea of the study, interpretation of data analysis, reported the results and drafted the manuscript.

Author 2: participated in summarized and drafted the manuscript.

Author 3, 4, 5: supervised the project's progress and responsible for the concept and project development. All authors contributed to the preparation of the manuscript, reviewing and approving the final manuscript

References

- World Health Organization. (2017). Maternal, newborn, child and adolescent health: Adolescent development. http://www.who.int/maternal_child_adolescent/topics/adolescence/dev/en/
- Virginia A. Stallings, & Ann L. Yaktine, Editors. (2007). Nutrition Standards for Foods in Schools: Leading the Way toward Healthier Youth. (2007). Chapter 2. Nutrition-Related Health Concerns, Dietary Intakes, and Eating Behaviours of Children and Adolescents. The National Academies Press Open Book. pp29-30. <https://doi.org/10.17226/11899>
- Wang, G., & Dietz, W. H. (2002). Economic burden of obesity in youths aged 6 to 17 years: 1979–1999. *Pediatrics*, 109(5), e81-e81.
- Sahoo, K., Sahoo, B., Choudhury, A. K., Sofi, N. Y., Kumar, R., & Bhadoria, A. S. (2015). Childhood obesity: causes and consequences. *Journal of family medicine and primary care*, 4(2), 187.
- Freedman, D. S., Dietz, W. H., Srinivasan, S. R., & Berenson, G. S. (1999). The relation of overweight to cardiovascular risk factors among children and adolescents: the Bogalusa Heart Study. *Pediatrics*, 103(6), 1175-1182.
- American Diabetes Association. (2016). Index. *Diabetes Care*, 39(Supplement 1), S109-S112.
- Institute for Public Health (IPH). (2012). The National Health and Morbidity Survey: National School-Based Nutrition Survey 2012. Ministry of Health Malaysia.
- World Health Organization. (2006). *Adolescent nutrition: a review of the situation in selected South-East Asian countries* (No. SEA-NUT-163). WHO Regional Office for South-East Asia. <https://apps.who.int/iris/handle/10665/204764>
- Case, A., Fertig, A., & Paxson, C. (2005). The lasting impact of childhood health and circumstance. *Journal of health economics*, 24(2), 365-389. <https://doi.org/10.1016/j.jhealeco.2004.09.008>

- De Onis, M., Blössner, M., Borghi, E., Frongillo, E. A., & Morris, R. (2004). Estimates of global prevalence of childhood underweight in 1990 and 2015. *Jama*, 291(21), 2600-2606. <https://doi/10.1001/jama.291.21.2600>
- Institute for Public Health (IPH). (2008). The third National Health and Morbidity Survey (NHMS III) 2006. Nutritional Status. Ministry of Health Malaysia.
- Institute for Public Health (IPH). (2015). National Health and Morbidity Survey 2015 (NHMS 2015). Vol. II: Non-Communicable Diseases, Risk Factors & Other Health Problems; 2015. Ministry of Health Malaysia.
- David Wogan. (2014). Research Data Collection Methods: Paper vs. Tablets. <https://www.quicktapsurvey.com/blog/research-data-collection-methods-paper-vs-tablets/>
- ICAP. (2015). There's an App for That: Using Tablets for PHIA Data Collection. <https://phia.icap.columbia.edu/theres-an-app-for-that-using-tablets-for-phia-data-collection/>.
- Wiegand, H. (1968). Kish, L.: Survey Sampling. John Wiley & Sons, Inc., New York, London 1965, IX+ 643 S., 31 Abb., 56 Tab., Preis 83 s. *Biometrische Zeitschrift*, 10(1), 88-89.
- Yusoff, F., Saari, R., Naidu, B. M., Ahmad, N. A., Omar, A., & Aris, T. (2014). Methodology of the national school-based health survey in Malaysia, 2012. *Asia Pacific Journal of Public Health*, 26(5_suppl), 9S-17S.
- Nutritionist Pro (Axyx Systems, Stafford, TX) software
- SPSS, I. IBM Corp; Armonk, NY: 2012. *IBM SPSS statistics for windows, version, 21*.
- Naing, L., Winn, T., & Rusli, B. N. (2006). Practical issues in calculating the sample size for prevalence studies. *Archives of orofacial Sciences*, 1, 9-14.
- WHO (2016). Steps in applying Probability Proportional to Size (PPS) and calculating Basic Probability Weights. https://www.who.int/tb/advisory_bodies/impact_measurement_taskforce/meetings/prevalence_survey/psws_probability_prop_size_bierrenbach.pdf
- World Health Organization, & Centers for Disease Control and Prevention (CDC). (2013). Global school-based student health survey (GSHS). <https://www.cdc.gov/gshs/pdf/GSHSOVerview.pdf>
- Northern Illinois University (2003-2004). Responsible Conduct of Research (RCR) website at Northern Illinois University. Responsible Conduct in Data Management: Data Collection. https://ori.hhs.gov/education/products/n_illinois_u/datamanagement/dctopic.html