

Knowledge, Attitude and Practice Regarding Type 2 Diabetes Mellitus Among Outpatients in a Health Center in East-Coast of Peninsular Malaysia

Malezya Yarımadası'nın Doğu Kıyısındaki Bir Sağlık Merkezindeki Ayaktan Hastalar Arasında Tip 2 Diabetes Mellitus ile ilgili Bilgi, Tutum ve Uygulama

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ABSTRACT

Introduction: Type 2 diabetes mellitus (T2DM) is becoming a global epidemic and a threat to the world population.

Methods: This cross-sectional study was carried out to assess the knowledge, attitude, and practice (KAP) regarding T2DM among outpatients of a health center in East-Coast of Peninsular Malaysia. A total of 104 participants aged above 18 years were selected using purposive sampling by the researcher to answer an interviewer-guided questionnaire. The total scores for each KAP were computed to find the associations using SPSS.

Results: There were significant correlations between knowledge and practice ($r=0.481$, $p<0.001$) and between age of participants with knowledge ($r=0.562$, $p<0.001$) and practice regarding T2DM ($r=0.607$, $p<0.001$). Besides, there was also a significant difference in terms of knowledge and practice regarding T2DM between different sexes and education levels. However, while making a comparison between Malays and other races, the significant difference was only found for practice regarding T2DM. The attitude was found to be similar in all groups. T2DM can be prevented by having accurate knowledge, adopting a positive attitude and practicing a healthy lifestyle.

Conclusion: Therefore, policies and campaigns which may change people's knowledge, attitudes, and practices for preventing T2DM should be properly formulated and implemented to tackle this health issue.

Keywords: Knowledge, attitude, practice, type 2 diabetes mellitus, outpatients, health center, East-Coast, Peninsular Malaysia

ÖZ

Amaç: Tip 2 diabetes mellitus (T2DM) küresel bir salgın ve dünya nüfusu için bir tehdit haline gelmiştir.

Yöntemler: Bu kesitsel çalışma, Doğu Malezya Yarımadası'ndaki bir sağlık merkezinin ayaktan başvuru yapan hastalarında T2DM ile ilgili bilgi, tutum ve uygulamaları arasındaki ilişkiyi (BTU) değerlendirmek amacıyla yapıldı. On sekiz yaşından büyük toplam 104 katılımcı araştırmacı tarafından rehberlik edilen ankete cevap vermek amacıyla örnekleme seçilmiştir. Her bir BTU için toplam puanlar arasındaki ilişki SPSS kullanılarak hesaplandı.

Bulgular: Bilgi ve uygulama arasında ($r=0,481$, $p<0,001$), katılımcıların yaşı ve bilgi düzeyi ($r=0,562$, $p<0,001$) ve T2DM ile ilgili uygulama arasında ($r=0,607$, $p<0,001$) anlamlı korelasyon bulundu. Ayrıca, farklı cinsiyetler ve eğitim düzeyleri arasında T2DM ile ilgili bilgi ve uygulama açısından da anlamlı bir farklılık vardı. Ancak, Malaylar ve diğer ırklar arasında karşılaştırma yaparken, önemli fark sadece T2DM ile ilgili uygulama için bulundu. Tutum tüm gruplar arasında benzer bulunmuştur. T2DM doğru bilgiye sahip olarak, olumlu bir tutum benimseyerek ve sağlıklı bir yaşam tarzı uygulayarak önlenabilir.

Sonuç: Bu nedenle, T2DM'yi önlemeye yönelik insanların bilgi, tutum ve pratiğini değiştirebilecek politika ve kampanyalar bu sağlık sorununu çözmek için uygun şekilde formüle edilmeli ve uygulanmalıdır.

Anahtar Kelimeler: Bilgi, tutum, uygulama, tip 2 diabetes mellitus, ayakta tedavi, sağlık merkezi, doğu sahili, Yarımada Malezya



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Introduction

There are approximately 371-415 million people with diabetes mellitus (DM) across the world and around 50% of them are not diagnosed (1,2). The WHO estimates that diabetes will be the seventh main cause of death by 2030 (3). DM is still known as the most common chronic disease worldwide despite many interventions and research (3). The major factors for DM are obesity, unbalanced diet, and unhealthy lifestyles. Moreover, poor awareness and practices are other most important factors that lead to DM. The prevalence of DM is increasing globally, which is not only limited to affluent countries. Middle-income countries are also among the most markedly affected ones (1,2). Diabetes Research and Clinical Practice has reported that ¾ of diabetic patients at the age range of 18-99 years currently live in low- and middle-income countries and it has forecasted that the number of these patients would rise to 673 and 693 million by 2040 and 2045, respectively (2,4). Despite this shocking number of DM patients, it has been recognized that type 2 (T2) DM can be prevented (5). Therefore, suitable preventive approaches need to be designed clearly based on the factors causing diabetes. The adaptation of a healthy lifestyle is greatly influenced by knowledge (6). The prevalence of DM reported from a National Health and Morbidity Survey done in Malaysia in 2006 was 11.6%, where the highest prevalence was in Indian (19.9%), followed by Malays (11.9%) and Chinese (11.4%) (7). Another study revealed that the prevalence was increased practically double that of the figure in 2006 to reach 22.6% in about twenty years' time. They also found hemoglobin A1c as a better predictive cut-off point in detecting new cases of DM in the multi-ethnic population in that study (8). The alarming increase in the prevalence of DM in Malaysia becomes a burden to the country. The occurrence of DM is thought to be influenced by knowledge, attitude, and practice (KAP) of the population (9). However, it was observed that patients might possess a reasonable level of knowledge regarding DM, but their attitudes towards diabetes care were insignificant (10).

Thus, this study was done generally for focusing on KAP regarding T2DM among patients attending a health center in the East-Coast of Peninsular Malaysia. The participants of this study were the outpatients who did not have any history of DM because the diabetic patients or anyone with the history of DM usually tend to have high knowledge about the disease due to the consultation with the physicians who can be a good source of health information regarding the disease itself (11). The results and findings of this study may assist the healthcare practitioners in tailoring their educational programs and appropriate preventive measures depending on the needs of the population to improve diabetes control.

Methods

Study Area: This study was carried out in a health center in the East-Coast of Peninsular Malaysia.

Source of Population: The participants were selected among outpatients in the selected health center.

Study Design: This was a cross-sectional study.

Study Period: The survey included cases from January 27, 2014 until January 31, 2014.

Sample Size Calculation: Using the Power and Sample Size Software version 3.0.43, the calculated sample size was 110, with the assumption of $\alpha=0.05$, power of study=0.8, $m=1$, $\delta=0.32$ and $\sigma=0.81$. The standard deviation (SD) ($\sigma=0.81$) was taken from a previous study (11).

Sampling Method: One hundred and four (104) study participants were selected by convenience sampling from the Outpatient Department of the selected health center considering inclusion and exclusion criteria.

Inclusion Criteria: This study included participants from both genders and with all education levels, regardless of their income status.

Exclusion Criteria: Diabetic patients and participants below 18 years old were excluded from the survey.

Research Tool and Data Collection: Data were collected by a set of interviewer-guided questionnaire which was distributed among the participants. The questionnaires were prepared in two languages, English and Malay languages. The questions had been constructed to be relevant according to the category of KAP regarding T2DM. The content validity of the questionnaires was checked by experts, and a pilot study had been done for face validity to improve the understandability of the questionnaire. A few corrections and amendments had been made to improve the questionnaires after the pilot study. The permission was obtained from the health center authority to do the survey. There were four sections which consisted of the socio-demographic variables (age, sex, education level, race and citizenship), the knowledge ("yes" or "no" answers), attitude (level of agreement or disagreement) and practices ("often", "seldom" or "never" answers) about T2DM and its prevention.

Ethical Approval: The study obtained ethical approval from both Medical Research and Ethics Committee, Ministry of Health Malaysia [KKM/NIHSEC/P14-374, Dated May-21-2014] and IIUM Research Ethics Committee [IIUM/310/G/20/4/14-42. Dated December-26-2013]. The written informed consent was obtained from the patients after full explanation of the nature and purpose of the study and all procedures used for the study.

Statistical Analysis

Data were analyzed using SPSS 21 (IBM, Armonk, NY, United States of America). Frequencies and percentages were used to describe the socio-demographic characteristics of the participants while Pearson correlation test was used to assess the association between KAP practice scores regarding T2DM, and their association with age of the participants. Independent t-test was employed to compare the KAP scores between different sexes and education levels, but in the comparison between Malays and other races, Mann-Whitney test was used because of the skewed distribution of the very small sample size of the other races group.

Results

Socio-Demographic Characteristics of Respondents

The total of 104 respondents involved in this study were outpatients attending the selected health center. The respondents' socio-demographic characteristics were obtained through the first part of the questionnaire. The range of respondents' age was between 18 and

70 years. The mean age of respondents was 32.1 (SD=13.46) years. The distribution of their sexes, educational levels, and races are shown in Table 1. More than half [52.9% (55)] of the respondents were males and had a secondary level of education [56.7% (59)] while the majority of them were Malays [91.3% (95)] and all were Malaysians.

Knowledge of Respondents Regarding T2DM

Most respondents knew that diabetes was a chronic health problem [82.7% (86)], it was worldwide [92.3% (96)], and it could be prevented [84.6% (88)]. Respondents identified the risk factors for diabetes as genetics [62.5% (65)], obesity [83.7% (87)], physical inactivity [96.2% (100)], poor dietary habit [84.6% (88)] and race [8.7% (9)]. The early symptoms of T2DM, which were correctly answered by the respondents, were extreme hunger [43.3% (45)], unusual thirst [72.15% (75)], frequent urination especially at night [75.0% (78)], numbness in hands or feet [76.0% (79)], blurred vision [35.6% (37)], increased fatigue [84.6% (88)], frequent infections [55.8% (58)], slow wound healing [85.6% (89)], and diarrhea [46.2% (48)]. Nevertheless, some wrongly answered prolonged cough [77.9% (81)] as an early symptom. The respondents identified the complications of T2DM as blindness [57.7% (60)], amputation [71.2% (74)], cardiovascular diseases [53.8% (56)], kidney disease [69.2% (72)],

and difficulty in breathing [25.0% (26)]. Regarding the preventions of T2DM, the respondents correctly answered as losing weight [94.2% (98)], regular physical activity [97.1% (101)], low-fat diet [90.4% (94)], avoiding high calorie diet [64.4% (67)], low-sugar intake [94.2% (98)], and avoiding high-salt diet [74.0% (77)].

The Attitude of Respondents Regarding T2DM

The majority [99.05% (103)] of the respondents agreed that doing regular exercise had a lot of benefits. Nonetheless, a big portion [93.3% (97)] of respondents wrongly believed that food containing more sugar improved health. All the respondents stated that the prevention of T2DM was important. Besides, only one of the respondents did not agree that loss of weight and diet control were the preventive measures for T2DM. One hundred percent of them believed that screening for T2DM was important and advantageous. All agreed that it was essential to control diet intake to keep their blood sugar in the normal range.

Practice of Respondents Regarding T2DM

Only 26.0% (27) and 32.8% (34) of the respondents read about DM and the overall health, respectively. Forty-three (41.3%), 24 (23.1%), and 6 (5.8%) of the respondents did physical activities regularly, tried to lose weight, and never took sweetened food or drinks, respectively. Only 26.0% (27), and 19.2% (20) of the respondents were concerned about reducing fat and calories in their diet and had the blood test done for T2DM, respectively. Furthermore, 17.3% (18) of them always consumed sweet food and drinks, which is not a healthy practice.

Association between Knowledge, Attitude, and Practice scores Regarding T2DM

The Pearson correlation test showed no significant association between knowledge and attitude scores regarding T2DM (r=0.178; p=0.070), nor between attitude and practice scores (r=0.074, p=0.455). However, there was little positive significant correlation between knowledge and practice scores regarding T2DM (r=0.481, p<0.001), which meant that higher knowledge scores were associated with better practice regarding T2DM.

Association between Ages with KAP scores Regarding T2DM

The Pearson correlation test showed no significant correlation between age and attitude scores regarding T2DM (r=0.067, p=0.500). However,

Table 1. Socio-demographic characteristics of the respondents (n=104)

	Frequency	Percentage
Sex		
Male	55	52.9
Female	49	47.1
Education level		
No formal education	1	1.0
Primary education	6	5.8
Secondary education	59	56.7
Tertiary education	38	36.5
Race		
Malay	95	91.3
Chinese	4	3.8
Indian	4	3.8
Others	1	1.0

Table 2. Comparison of knowledge, attitude and practice scores regarding type 2 diabetes mellitus among sex, educational level and race (n=104) using independent t-test

Characteristic	n	Knowledge		Attitude		Practice	
		Mean (SD)	p	Mean (SD)	p	Mean (SD)	p
Sex							
Male	55	73.7 (6.31)	0.001	20.8 (0.62)	0.226	16.4 (2.72)	0.028
Female	49	77.9 (5.70)		20.9 (0.34)		17.6 (2.98)	
Education							
Lower level	66	74.4 (5.95)	0.004	20.9 (0.40)	0.381	16.5 (2.77)	0.020
Upper level	38	78.1 (6.46)		20.8 (0.66)		17.8 (2.94)	
Race							
Malay	95	77.0 (8.0) ^a	0.871^b	21.0 (0) ^a	0.337 ^b	17.0 (3.0) ^a	0.047^b
Others	9	77.0 (9.0) ^a		21.0 (0) ^a		19.0 (5.0) ^a	

aMedian (IQR). bMann-Whitney test

the Spearman correlation test showed a moderate-to-good positive significant correlation between age and knowledge scores regarding T2DM ($r=0.562$, $p<0.001$), also between age and practice scores ($r=0.607$, $p<0.001$), meaning that older participants had better knowledge and practice regarding T2DM.

Comparison of KAP scores Regarding T2DM among Different Sexes, Education Levels, Races and Occupations

Table 2 shows the comparison of KAP scores regarding T2DM among different sexes, education levels and races. For this purpose, the levels of education were re-categorized into lower education which included informal, primary and secondary education and higher education level that also included tertiary education. All the races besides Malay were combined into "others" type of race. The findings showed that the knowledge and practice scores regarding T2DM were significantly higher in females compared to males ($p=0.001$ and 0.028 , respectively) and significantly higher in those with higher education compared to those with lower education level ($p=0.004$ and 0.020 , respectively). Practice scores were also found to be significantly lower in Malays compared to other races ($p=0.047$) while no significant difference was found for attitude scores among all the groups, nor for knowledge between Malays and other races.

Discussion

DM is becoming a global public health threat with an alarmingly increasing rate, making DM as an epidemic disease and an estimated 693 million people are projected to suffer from the disease by 2045 (4). Additionally, it is estimated that about 193 million patients with DM will continue to be unidentified because of the minimum initial symptoms, particularly in T2DM (12).

All respondents who participated in this study were Malaysian, possibly because the study was performed in a public health clinic in Malaysia. Most of them were Malay, which could be due to the high number of Malays in the nearby communities. Majority of the respondents attained a secondary and tertiary education level, which is consistent with the Malaysian education policy (13).

Most of the respondents knew that DM was a chronic health problem and could be prevented. This might be due to the phenomenon of DM that happens throughout the world. Previously, T2DM was only known to happen in Western countries. However, DM has now spread to almost every country throughout the world (14). Majority of respondents knew about the risk factors of T2DM including genetic factor, obesity, physical inactivity and poor dietary habits, which is good because they can take the important preventive measures indicated to reduce their risk of getting the disease. However, most of the respondents did not know that race was one of the risk factors of T2DM. Race is a risk factor for T2DM as it is known that certain ethnic group suffers from DM more than others (15).

Most of the respondents knew the correct early symptoms of T2DM, and therefore, they should be able to get early treatment for the disease. The low level of knowledge regarding DM in a community portrays the extent of health promotion for most chronic non-communicable diseases

(16). One study covering five different sub-Saharan countries reported that there were still no effective primary care programs for DM (17). Malaysian public health system is much more effectively operated in comparison to sub-Saharan countries; therefore, people are commonly quite aware regarding the early symptoms of DM. Respondents were mostly aware of the complications of T2DM. However, most of them did not know about breathing difficulty as one of its complications, which could be due to the late cardiovascular complications. Awareness level was quite consistent with another study report which reported that cognizance and responsiveness was a principal determinant for control and prevention of DM (18).

All respondents agreed that prevention of T2DM was important, and most of them also agreed that physical exercise benefited a lot. If this awareness is taken into action, it can prevent them from getting not only the disease, but also a few other chronic diseases such as cardiovascular diseases. People's daily diet intake is influenced by their habits acquired since childhood (19). Schools and other education settings have long been considered a primary target to deliver nutrition education (20). Proper nutrition is essential for the physical and mental development of children and adolescents, which means school children are at the phase of life when they are adapting habits that will last a lifetime; and children are an important link among school, home, and community (21). The current study findings were in the same line of healthy lifestyle and DM prevention strategies.

Weight loss and diet control could help in the prevention of T2DM. Multiple studies have reported that healthy lifestyle such as proper diet and regular exercise can prevent and improve T2DM (5,22). Besides, losing 5-10% of body weight can reduce the risk of getting DM (23). Subsequently, the current study respondents' opinion was quite scientifically valid and up to date. Most of the respondents believed that screening for T2DM was important and advantageous. Other study reported similarly regarding the importance of regular screening (24).

All respondents in the current study knew that it was essential for diabetic patients to control their diet to keep their blood sugar level in the normal range. Higher dietary glycemic load and trans-fat are associated with increased diabetes risk, whereas greater consumption of cereal fiber and polyunsaturated fat is associated with decreased risk (14). Overseas studies similarly recommended diet and glycemic control (25). Thus, it is very important to educate the public on proper and healthy nutrition intake to maintain a normal range of blood sugar level.

From the results on practice regarding T2DM in the current study, it can be deduced that practice regarding T2DM among respondents was not at a satisfactory level. Therefore, there is a need to improve knowledge and awareness about diabetes in order to improve their practice accordingly. Community level awareness programs need to be launched to increase awareness (26).

The current study shows no significant correlation between knowledge and the attitude of the respondents regarding T2DM. Thereafter, it can be concluded that the knowledge of respondents did not contribute to their attitudinal change regarding T2DM. Similarly, good attitude alone did not contribute to having a healthy practice and is insufficient to

prevent T2DM. Other factors, such as motivation and awareness are also important (27). Psychological determinants of health behavior such as reasons, goals, expectations, values, beliefs, or self-perceptions will enhance the individual getting more motivation in managing their health, especially in preventing T2DM (28).

T2DM is a disease of people in older age-group, which might explain the reason for that most of the respondents at an older age could be more keen on ensuring their health, which might contribute to the betterment of their knowledge and practice regarding T2DM. Women could also be more aware of health issues and therefore, more likely to consult doctors compared to men. Therefore, women appear to have higher health problem rates than men, but this may reveal the fact that more men health problems are under-reported (29).

Even though the current study found no association between level of education and KAP regarding T2DM, it was found that people having a longer period of schooling tend to have better health due to their healthier lifestyles (30). This is supported by the results of the current study where those with higher education levels showed higher knowledge and practice scores. "Education improves health because it increases effective agency, enhancing a sense of personal control that encourages and enables a healthy lifestyle. Education's beneficial effects are pervasive, cumulative, and self-amplifying, growing across the life course" (31). Another study describes education as an important instrument for improving the overall physical and mental health of persons and folks because education promotes "healthy lifestyles and positive choices, supporting and nurturing human development, human relationships and personal, family and community well-being" (32). Thereafter, it cuts down health care costs at an individual and community level (32). The race of the respondents was not found to be significantly associated with their knowledge and attitude regarding T2DM. However, there was a significant association between races and practice regarding T2DM. This shows that race affects health (33).

Study Limitations

The nature of the current study does not allow for the conclusion of a causal-effect relationship because the temporal sequence of relationship cannot be ensured using a cross-sectional design as applied in this study. The complete generalization to the population needs to be done with caution because of the convenience sampling that was used. Therefore, it is recommended that further studies should be conducted by using a cohort or experimental design to ensure that the variables investigated are in a causal-relationship with the outcomes studied.

Conclusion

The knowledge regarding T2DM among the respondents in the current study was quite satisfactory as most questions was correctly answered by most or at least more than half of the participants. Although many of them showed a positive attitude towards T2DM, there were still many needs to be targeted to improve their awareness about the importance of screening for diabetes and healthy lifestyle in preventing T2DM. Knowledge was also found to be significantly correlated with practice regarding T2DM, as were age with knowledge and practice. Knowledge and practice regarding T2DM were all found to be significantly different

between different sexes and levels of education, also for practice among different races.

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Ethics Committee Approval: The study obtained ethical approval from both Medical Research and Ethics Committee, Ministry of Health Malaysia (KKM/NIHSEC/P14-374, Dated May-21-2014) and IIUM Research Ethics Committee (IIUM/310/G/20/4/14-42. Dated December-26-2013).

Informed Consent: The written informed consent was obtained from the patients after full explanation of the nature and purpose of the study and all procedures used for the study.

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References

- Castillo M. 371 million people have diabetes globally, about half undiagnosed. CBS News. 2012. Available at <https://www.cbsnews.com/news/371-million-people-have-diabetes-globally-about-half-undiagnosed/> (Accessed August 24, 2018)
- World Health Organization (WHO). Diabetes. Key Facts. 2017. Available at <http://www.who.int/news-room/fact-sheets/detail/diabetes> (Accessed August 24, 2018).
- Sahoo K, Sahoo B, Choudhury AK, Sofi NY, Kumar R, Bhadoria AS. Childhood obesity: causes and consequences. *J Family Med Prim Care* 2015; 4: 187-92.
- Cho NH, Shaw JE, Karuranga S, Huang Y, da Rocha Fernandes JD, Ohlrogge AW, et al. IDF Diabetes Atlas: Global estimates of diabetes prevalence for 2017 and projections for 2045. *Diabetes Res Clin Pract* 2018; 138: 271-81.
- Asif M. The prevention and control the type-2 diabetes by changing lifestyle and dietary pattern. *J Educ Health Promot* 2014; 3: 1.
- Tiedje K, Wieland ML, Meiers SJ, Mohamed AA, Formea CM, Ridgeway JL, et al. A focus group study of healthy eating knowledge, practices, and barriers among adult and adolescent immigrants and refugees in the United States. *Int J Behav Nutr Phys Act* 2014; 11: 63.
- Letchuman GR, Wan Nazaimoon WM, Wan Mohamad WB, Chandran LR, Tee GH, Jamaiah H. et al. Prevalence of diabetes in the Malaysian National Health Morbidity Survey III 2006. *Med J Malaysia* 2010; 65: 180-6.
- Wan Nazaimoon WM, Md Isa SH, Wan Mohamad WB, Khir AS, Kamaruddin NA, Kamarul IM, et al. Prevalence of diabetes in Malaysia and usefulness of HbA1c as a diagnostic criterion. *Diabet Med* 2013; 30: 825-8.
- Fatema K, Hossain S, Natasha K, Chowdhury HA, Akter J, Khan T, et al. Knowledge attitude and practice regarding diabetes mellitus among nondiabetic and diabetic study participants in Bangladesh. *BMC Public Health* 2017; 17: 364.

10. Herath HMM, Weerasinghe NP, Dias H, Weeraratna TP. Knowledge, attitude and practice related to diabetes mellitus among the general public in Galle district in Southern Sri Lanka: a pilot study. *BMC Public Health* 2017; 17: 535.
11. Shrestha L, Nagra JS. Knowledge, Attitude, and Practice (KAP) Study on diabetes mellitus among nepalese diabetic patients. *Nepal Med Coll J* 2005; 7: 51-3.
12. International diabetes federation. IDF Diabetes Atlas, 7th Edition. Available at <http://www.diabetesatlas.org/> (Accessed August 25, 2018).
13. Student Info & Guide. A Glance at the malaysian education system. 2015. Available at <https://www.studymalaysia.com/education/higher-education-in-malaysia/a-glance-at-the-malaysian-education-system> (Accessed August 25, 2018).
14. Hu BF. Globalization of Diabetes: The role of diet, lifestyle, and genes. *Diabetes Care* 2011; 34: 1249-57.
15. Bancks MP, Kershaw K, Carson AP, Gordon-Larsen P, Schreiner PJ, Carnethon MR. Association of modifiable risk factors in young adulthood with racial disparity in incident type 2 diabetes during middle adulthood. *JAMA* 2017; 318: 2457-65.
16. Ichiho HM, Demei Y, Kuartei S, Aitaoto N. An assessment of non-communicable diseases, diabetes, and related risk factors in the republic of palau: A systems perspective. *Hawai J Med Public Health* 2013; 72(5 Suppl 1): 98-105.
17. Azevedo M, Alla S. Diabetes in Sub-Saharan Africa: Kenya, Mali, Mozambique, Nigeria, South Africa and Zambia. *Int J Diabetes Dev Ctries* 2008; 28: 101-8.
18. Mumu SJ, Saleh F, Ara F, Haque MR, Ali L. Awareness regarding risk factors of type 2 diabetes among individuals attending a tertiary-care hospital in Bangladesh: a cross-sectional study. *BMC Res Notes* 2014; 7: 599.
19. Birch L, Savage JS, Ventura A. Influences on the development of children's eating behaviors: from infancy to adolescence. *Can J Diet Pract Res* 2007; 68: 1-56.
20. Sadegholvad S, Yeatman H, Parrish AM, Worsley A. what should be taught in secondary schools' nutrition and food systems education? Views from prominent food-related professionals in Australia. *Nutrients*. 2017; 9: 1207.
21. Hawkes C. Promoting health diets through nutrition education and changes in the food environment: an interventional review of actions and their effectiveness. International Conference on Nutrition. 2013. Available at <http://www.fao.org/docrep/017/i3235e/i3235e.pdf> (Accessed August 25, 2018).
22. Amuta AO, Mkuu R, Jacobs W, Barry AE. Number and severity of type 2 diabetes among family members are associated with nutrition and physical activity behaviors. *Front Public Health* 2017; 5: 157.
23. Wing RR, Lang W, Wadden TA, Safford M, Knowler WC, Bertoni AG, et al. Benefits of modest weight loss in improving cardiovascular risk factors in overweight and obese individuals with type 2 diabetes. *Diabetes Care* 2011; 34: 1481-6.
24. Gilmer TP, O'Connor PJ. The growing importance of diabetes screening. *Diabetes Care* 2010; 33: 1695-7.
25. Shrivastava SR, Shrivastava PS, Ramasamy J. Role of self-care in management of diabetes mellitus. *J Diabetes Metab Disord* 2013; 12: 14.
26. Muninarayana C, Balachandra G, Hiremath SG, Iyengar K, Anil NS. Prevalence and awareness regarding diabetes mellitus in Rural Tamaka, Kolar. *Int J Diabetes Dev Ctries* 2010; 30: 18-21.
27. Saleh F, Mumu SJ, Ara F, Ali L, Hossain S, Ahmad KR. Knowledge, attitude, and practice of type 2 diabetic patients regarding obesity: study in a tertiary care Hospital In Bangladesh. *J Public Health Afr* 2012; 3: 8.
28. Teixeira PJ, Mata J, Williams GC, Gorin AA, Lemieux S. Self-regulation, motivation and psychosocial factors in weight management. *J Obes* 2012; 2012: 582348.
29. von Bothmer MI, Fridlund B. Gender differences in health habits and in motivation for a healthy lifestyle among swedish university students. *Nurs Health Sci* 2005; 7: 107-18.
30. Kaplan R, Spittel M, David D (Eds). Population health: behavioral and social science insights. AHRQ Publication No. 15-0002. Rockville, MD: Agency for healthcare research and quality and office of behavioral and social sciences research, National Institutes of Health; July 2015. Available at <https://www.ahrq.gov/sites/default/files/publications/files/population-health.pdf> (Accessed August 25, 2018).
31. Feinstein L, Sabates R, Anderson TM, Sorhaindo A, Hammond C. What are the effects of education on health? Measuring the effects of education on health and civic engagement. *Proceedings of the Copenhagen Symposium*; 2006. Available at <http://www.oecd.org/education/innovation-education/37437718.pdf> (Accessed August 25, 2018).
32. Mirowsky J, Ross CE. Education, learned effectiveness and health. *London Rev Educ* 2005; 3: 205-20.
33. Nicklett EJ. Socio-economic status and race/ethnicity independently predict health decline among older diabetics. *BMC Public Health*. 2011; 11: 684.