**VALIDATION OF MALAYSIAN SUGAR CRAVING ASSESSMENT TOOL (MYSCAT) AMONG TYPE II DIABETIC PATIENTS**

MAYS JAMAL ALI, (CORRESPONDING AUTHOR)

DEPARTMENT OF NUTRITION SCIENCES, KULLIYYAH OF ALLIED HEALTH SCIENCES, INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA, JLN SULTAN AHMAD SHAH BADER INDERA MAHKOTA 25200 KUANTAN, PAHANG, MALAYSIA

[mayoosa\_j@yahoo.com](mailto:mkbiol@yahoo.com)

ASSOC. PROF. DR. NIK MAZLAN MAMAT

DEPARTMENT OF NUTRITION SCIENCES, KULLIYYAH OF ALLIED HEALTH SCIENCES, INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA, JLN SULTAN AHMAD SHAH BADER INDERA MAHKOTA 25200 KUANTAN, PAHANG, MALAYSIA

[nikmazlan@iium.edu.my](http://www.iium.edu.my/staff/show/4617)

DR. WAN FATHIN FARIZA BT. WAN MAHMOOD

DEPARTMENT OF NUTRITION SCIENCES, KULLIYYAH OF ALLIED HEALTH SCIENCES, INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA, JLN SULTAN AHMAD SHAH BADER INDERA MAHKOTA 25200 KUANTAN, PAHANG, MALAYSIA

[wfathin@iium.edu.my](http://www.iium.edu.my/staff/show/4587)

DR. ARYATI BINTI AHMAD

PUSAT PENGURUSAN PENYELIDIKAN, INOVASI & PENGKOMERSILAN UNIVERSITI SULTAN ZAINAL ABIDIN GONG BADAK, 21300 KUALA TERENGGANU, TERENGGANU

[aryatiahmad@unisza.edu.my](mailto:aryatiahmad@unisza.edu.my)

SHAHEEDA BINTI RAZALI

KILNIK KESIHATAN HILIRAN, JLN KEMAJUAN BUKIT KECIL, 20548 KUALA TERENGGANU, TERENGGANU, MALAYSIA

[shaheedajoe@gmail.com](mailto:shaheedajoe@gmail.com)

**ABSTRACT**

**Introduction:** The purpose of this study is to validate Sugar Craving Assessment Tool (MySCAT) among type II diabetes mellitus patients. **Methods:** A total of 168 respondents were recruited to participate in this cross sectional study. It was conducted in out-patient health clinics in Kuala Terengganu and Kuantan. Patients’ sugar craving and dietary behavior were measures using structured questionnaires which were MySCAT, three-day dietary recall and demographic data. The interview sessions were conducted by a dietician. **Results:** MySCAT internal consistency test had a Cronbach’s alpha value of 0.75 and showed a significant correlation (*r*=0.56, *p* < 0.001) with actual sugar intake collected via three days diet recall. ROC analysis reported a cut-off point for MySCAT as 16.5; the sensitivity value of 0.83 and 1-specificity of 0.38. 62% of respondents were categorized as cravers and 38% as non-cravers. Male and female repondents had no significant differences in craving status. The mean intake of sugar was 46 g/day (SD= 2.26), respondents had a relatively high intake of sugar in comparison to their recommendation. **Conclusions:** This study found that MySCAT provides an easy efficient tool which is sensitive enough to identify those with sugar craving problem. It also provides an overview of patients’ dietary intake and points out their problem with dietary intake compliance. We suggest MySCAT as an important tool that can assist dietitians in their consultation session.

**KEYWORDS:** Diabetes patients (T2DM), sugar craving, MySCAT

**INTRODUCTION**

World Health Organization (WHO) estimated that more than 220 million people worldwide are having diabetes mellitus, where T2DM comprised 90% of that count (WHO, 2010). It was reported in 2015 that 1 in every 11 adults had T2DM globally and this finding suggests that T2DM had reached its epidemic levels accounting for 75% patients in the developing countries (IDF, 2015). The Ministry of Health Malaysia had published a statistical report that showed T2DM accounts for 90% to 95% of all diagnosed diabetic patients, affecting approximately 15.2% (2.6 million) of adults 18 years and above. The same survey estimated that for every person who is diagnosed with diabetes another remains undiagnosed.

Studies found that some food items had addictive qualities, and further if consumed excessively it can either increase the chances of developing diseases or reduce chances of survival of diseased individuals or help to prevent certain NCDs such as cancer and cardiovascular diseases (Doll and Peto, 1981; Bail et al., 2013). It was found that sugar has a salient effect on progressing of NCDs especially diabetes and serves as one of the major dietary risk factors to mortality from cardio metabolic risk (The Global Burden of Metabolic Risk Factors for Chronic Diseases Collaboration, 2014).

Letchuman et al., 2010 observed that there was a continuous increase of diabetes prevalence in about 80% over the past decade which was found to be parallel to the rise of sugar industry. Sugar had been discussed as an addictive food item. Amal et al., (2011) stated that we cannot deny the statistics and the projected hazards of excessive sugar intake by diabetic patients. The US Department of Agriculture in 2012 reported that there is a rise in sugar industry to meet the demand of the market which was found to be in line with the increasing rate of diabetes. They also reported that Malaysia had been ranked as one of the highest sugar importer countries in the world (USDA, 2012; Koo, 2017; Henderson et al., 2003; Whitton et al., 2011).

Diabetic patients have been struggling to control their sugar intake and manage their cravings; this constant non-compliance can speed up the patient’s prognosis (Khattab et al., 2010). Dietary compliance had been the spanner in the work of health professionals to manage diabetic patients (Henderson et al., 2003). As reported by Powers et al., (2017) those with compliance problem need special consideration from registered dietitians in their educational session to reach the ultimate glycaemic control. Time is one of the major obstacles in counseling sessions reported by dietitians hence; they tend to rush their counseling session (Lemon et al., 2007). Therefore there is a serious need to develop tools that can assist the dietitians during their counseling session. Sugar Craving Assessment Tool (MySCAT) has been developed by Wan, (2017) and validated to detect sugar craving among Malaysian adults. It was found to be sensitive enough to test the intensity of sugar cravings among normal population. For diabetic patients, MySCAT can be a useful screening tool that can highlight those who need extra care and further counseling to manage their sugar cravings.

**METHODS**

**Subjects**

A total of 168 respondents who were newly diagnosed T2DM from out-patients health clinics in Kuantan and Kuala Terengganu were recruited for this cross sectional study. Informed consent was obtained from the respondents. The protocol of the study was approved by the IIUM Research Ethics Committee (IREC) and National Medical Research Register (NMRR) Malaysia.

**Study Instruments**

All data were collected by forced choices and/or fill in the blanks based on the questionnaire as follow:

**Demographic Data Questionnaire**

Data collected includes the characteristic of a population to give an overall understanding of the population and to investigate if there is a link between these demographic data and sugar craving.

**Sugar Craving Assessment Tool (MySCAT)**

MySCAT is an interval/ratio scale that aims to measure sugar craving among Malaysian which consists of 30 questions (Wan, 2017). This tool contains common Malaysian habitual sugary food and beverage based on the Malaysian Atlas of Food Exchange & Portion size (Suzana et al., 2002). It ranges from the traditional *kuih* (with condiment)*;* pancakes; 3 in 1 instant drinks; soft drinks; drinks with sweetened condense milk; flavored milk; canned fruits; energy bars; *agar-agar; Ais Batu Campur* (ABCs); biscuits; popcorn with caramel; bun with fillings; cakes and muffin; candy and sweets; bananas dumpling; chocolate or flavored chocolates; *dodol*; donuts; fruit juices; ice-cream; egg jam; fruit jam; traditional sweets (*kuih)*.

**Three-Day Diet Recall**

The main purpose of this set is to measure the dietary intake especially carbohydrates. It was obtained by asking patients to recall back their intake of food and drinks over the period of two days and one weekend.

**Statistical analysis**

The data of this study was analyzed by using the Statistical Package for Social Sciences (SPSS) software programme. The results were presented as percentages or as descriptive statistic, correlation test and ROC analysis as follow:

## Internal Consistency Testing

The items were tested for internal consistency by using Cronbach’s alpha, a statistic calculated from the pairwise correlation between items, in which to determine the alpha. The reliability coefficient (alpha) was explained by Santos et al., (1999). It was confirmed by Espina et al., (2013) that a reliability coefficient (alpha) of 0.70 or higher is considered to be an acceptable reliability.

## Sensitivity and Specificity

The sensitivity and specificity were tested on continuous scale (MySCAT) which has a range between (never to always). The test was performed by dichotomizing the respondents into two groups. The data from the three-day diet recall was used as a standard to measure and report the sugar intake. The data were categorized according to the intake of sugar which is higher or lower than 10% based on the recommendations of the recent Medical Nutrition Therapy (MNT) guideline for T2DM patients. Those who reported an intake of sugar of more than 10% were considered positive and recorded as ‘Yes’ and was given a score of 1, and those who reported less than 10% intake of sugar were considered negative and recorded as ‘No’ was given a score of 0. The AUC indicated the ability of MySCAT to measure sugar cravings and report an optimal cut-off point for sugar craving.

**RESULTS**

## Respondent background

From a total of 168 respondents, 61 of them were males and 107 were females. Respondents participated voluntarily from out-patients health clinics in Kuantan and Kuala Terengganu.

## Validation Tests

## Internal Consistency

The reliability test of MySCAT tool was found to have a Cronbach’s alpha of 0.75 which represents a good consistency. The data were normally distributed based on the histogram graph and agreeably scattered around Y- axis based on our scatter graph with a Standard Deviation of 0.3.

**Table I** Reliability test for MySCAT tool

|  |  |
| --- | --- |
| **Reliability test (MySCAT) scale** | |
| Cronbach’s Alpha | 0.75 |
| Cronbach’s Alpha based on standardized items | 0.84 |
| No. of items (MySCAT) scale | 30 |
| No. of respondents | 168 |

The Cronbach’s alpha test for MySCAT was good based on the results obtained as shown in Table I, with 0.84 for all 30 MySCAT items. This indicates a good internal consistency for MySCAT scale to measure sugar craving among diabetic patients.

## Correlation of MySCAT and Sugar Intake

In measuring respondents’ sugar craving, MySCAT score had a mean value of 19.5 ± 9.0, the mode value was 21 with median of 19. The highest score was 55 and the lowest score was 3. Correlation analysis showed that those who reported high intake of sugar were correlated significantly with MySCAT score with correlation of 0.56 P > 0.001which has a strong correlation. The mean value for MySCAT, with a mean value of 19.5 ± 2.26, and sugar intake of 46 ± 19.0 as shown in Table II.

**Table II:** Correlation MySCAT Score and Sugar Intake

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Item** | **Mean** | **Std.deviation** | **Correlation with blood sugar markers** | **Sig** |
| MySCAT | 19.5 | 2.26 | 0.56**٭٭** | < 0.001 |
| Sugar | 46 | 19.0 |  |  |

**٭٭** Correlation is significant at the 0.01 level

**Figure 1.** Scatterplot shows correlation between MySCAT score and sugar intake

## ROC Analysis Test

We gathered our data and did a validity test on our data of (MySCAT) scale in the mean form. The result showed area under the ROC curve of (0.8) sensitivity of (0.83) and a specificity of (0.38), with CI level of (90%) ad p < 0.001. The cut-off point of MySCAT is 16.5 based on ROC analysis, higher than the cut-off points was to be considered as craver with a sensitivity of 0.83 1-specificity of 0.038 as shown in Table III.

**Table III:** Validity Test for MySCAT Tool

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Validity test (MySCAT) scale** | | **Sum** | **Mean** | ***P* value** |
| ROC curve (cut of points) | 16.5 | | 0.66 | 0.001 |
| Area under the Curve(AUC) | 0.8 | |  | 0.001 |
| Sensitivity | 0.83 | |  |  |
| Specificity | 0.38 | |  |  |

## Highest Craved Food

The highest top three craved food items in MySCAT by our population was sweetened beverage (instant coffee 3 in 1) with a mean value of 2.64 followed by another family of sweet drinks which include malted drinks with a mean value of 1.82 and lastly traditional sweets *kuih* with a mean value of 1.32. While the least craved food were pancake and waffles with a mean value of 0.05. There was no significant difference between male’s cravings and females cravings for different food items in MySCAT scale.

**Figure 2.** Overall Mean Score of Sugar Craving Based on Food Items among Respondents

**DISCUSSION**

## MySCAT Validation

## Internal Consistency Testing

The core focus of this study is validating MySCAT to measure diabetic patients’ sugar craving. MySCAT had a good internal consistency across its components based on Cronbach alpha test with a value of 0.75 and a Cronbach alpha of 0.8 for standardized items. This shows that MySCAT items are consistent enough to measure sugar craving.

Cronbach alpha test had been widely used as part of the validation process. It was firstly introduced by Cronbach, (1951), α= 0.7 and above is reliable enough and can identify that the desirable instrument have a stability (absence of change when test-retest) which means these sets of items of this particular instrument would give the same outcome (Taber, 2018).

## Correlation between MySCAT and Standardized Method

Three-day diet recall (two days and one weekend) was used as a standardized method to measure sugar craving. Strong linear correlation r= 0.56 was reported between MySCAT mean score and sugar intake mean score with *P* <0.001. Mukaka (2012) suggested that correlation can be misused by some researchers. Thus, the variables had been plotted using scatterplot diagram which can give an overall look on the synchronization of the data across the Y-axis and X- axis and determine the trend of the relationship between the variables. As shown in Figure 1, using MySCAT scale to measure sugar craving was reliable enough to be correlated with the data reported.

## Sensitivity and Specificity

The second part of the validation process is ROC analysis. The area under the curve (AUC) had a value of 0.8 with (Sensitivity = 0.83 and 1-Specificity = 0.38). These numbers indicate that MySCAT is sensitive enough to measure sugar craving and differentiate between cravers and non-cravers. The AUC area can identify the perfection of a particular tool to differentiate between the two verified conditions. (Hajian, 2013) suggested that AUC of value 0.5 and above can be considered good enough to differentiate between tow conditions.

The analysis gave a cut-off point of 16.5 (as shown in Table III). ROC analysis had been used in social and medical sciences base studies for far-off time since it can determine the usefulness of the desirable instrument and identify the ideal cut-off point for a particular test. However, some researchers seem to avoid using ROC analysis because it has been commonly misused to identifying positive and false negative cases in clinical screening of diagnostics test. Carter et al., (2016) argued that following simple rules of ROC guideline can produce more reliable and aid in analyzing and interpreting the results. The authors suggested following the guideline when crossing the points displayed on ROC curve appropriately can improve the outcome of the results.

**Sugar craving and intakes**

Despite the tremendous work of increasing health awareness in the past few years, the consumption of sugar in Malaysia is at an increasing trend. Malaysia had been ranked as one of the highest sugar importer in the world (USDA, 2012). Our result reported that the highest craved food was sweet drinks category which is instant coffee and sachet sweet drinks followed by drinks, condense based drinks and traditional sweets (*kuih)* in an accumulated percentage of more than 80% of our respondents who were cravers. The sweet food items were consumed two to three times per day, which is above the recommended level of sugar consumption for diabetic patients based on the Malaysian Medical Nutrition Therapy (MNT) recommendations (MDA, 2015). Unfortunately, our result were rather higher than Shahar and Rahman, whereby based on the Malaysian (Malay) based population dietary intake, they revealed that 72% of their respondents reported intake of sweets in morning and afternoon tea throughout the week (Shahar and Rahman, 2000).

Study by Lai (2010) on cultural influence eating habits reported that Asian value the tradition of drinking coffee (*kopi* time) through the past two centuries. Asian food stalls had changed to cope with urbanization and globalization. However, the amount of sugar consumption keeps increasing as well, in which it contributes to the increasing percentage of NCD. The National Health Morbidity Surveys time and again shows that Type II diabetes is the second most common chronic disease in Malaysia.

**CONCLUSION(S**)

We conclude that MySCAT is an easy to use tool that can identify sugar craving problem among diabetic patients efficiently. This study provides us with an overall picture on diabetic patients’ dietary intake, particularly of carbohydrate and sugar. We can also conclude that sugar craving might be associated with some demographic variables.

Dieticians require specific tools to assist them in their consultation session and MySCAT can be of help in understanding patients’ sugar craving. The efficiency of dietary intervention can be improved by using this tool, as those with craving issues can be detected easily using MySCAT. Proper intervention can be made to help patients with craving issues, whereby they can be enrolled in group counseling or have more frequent visits to the dietitians to review their sugar intake. This in turn can improve the patients’ dietary compliance and further improve their well-being.

**ACKNOWLEDMENT(S)**

We would like to thank all the participants who joined this study and help to facilitate this project from our dear diabetic patients and their caregivers to health professionals who helped made this project possible. We would like to thank the Medical Research and Ethics Committee (MREC) for approving our study.

**CONFLICT OF INTEREST**

The authors had no conflict of interest to declare.

**REFERENCES**

1. World Health Organization. (2010). *World health statistics 2010*. World Health Organization.
2. Doll, R., & Peto, R. (1981). The causes of cancer: quantitative estimates of avoidable risks of cancer in the United States today. *JNCI: Journal of the National Cancer Institute*, *66*(6), 1192-1308.
3. International Diabetes Federation. IDF Diabetes Atlas — 7th Edition. DiabetesAtlas http://www. diabetesatlas.org/ (2015).
4. Baik, I., Cho, N. H., Kim, S. H., & Shin, C. (2013). Dietary information improves cardiovascular disease risk prediction models. *European journal of clinical nutrition*, *67*(1), 25.
5. The Global Burden of Metabolic Risk Factors for Chronic Diseases Collaboration. (2014). *cardiovascular disease, chronic kidney disease, and diabetes mortality burden of cardio-metabolic risk factors between 1980 and 2010: comparative risk assessment*. The Lancet. Diabetes & Endocrinology, 2(8), 634–647.
6. Letchuman, G. R., Wan Nazaimoon, W. M., Wan Mohamad, W. B., Chandran, L. R., Tee, G. H., Jamaiyah, H., ... & Ahmad Faudzi, Y. (2010). Prevalence of diabetes in the Malaysian national health morbidity survey III 2006. *Med J Malaysia*, *65*(3), 180-186.
7. Amal, N. M., Paramesarvathy, R., Tee, G. H., Gurpreet, K., & Karuthan, C. (2011). Prevalence of Chronic Illness and Health Seeking Behaviour in Malaysian Population: Results from the Third National Health Morbidity Survey (NHMS III) 2006. The Medical journal of Malaysia, 66(1), 36-41.
8. US Department of Agriculture. Sugar: World Markets and Trade. Washington, DC: US Department Of Agriculture; May 2012.
9. Koo, W. W., & Taylor, R. D. (2008). *2008 Outlook of the US and World Sugar Markets, 2007-2017*. Center for Agricultural Policy and Trade Studies, Department of Agribusiness and Applied Economics, North Dakota State University.
10. Henderson, L., Gregory, J., & Swan, G. (2003). The National Diet and Nutrition Survey: adults aged 19 to 64 years. *Vitamin and mineral intake and urinary analytes. The Stationery Office, London, UK*.
11. Whitton, C., Nicholson, S. K., Roberts, C., Prynne, C. J., Pot, G. K., Olson, A., ... & Henderson, H. (2011). National Diet and Nutrition Survey: UK food consumption and nutrient intakes from the first year of the rolling programme and comparisons with previous surveys. *British journal of nutrition*, *106*(12), 1899-1914.
12. Khattab, M., Khader, Y. S., Al-Khawaldeh, A., & Ajlouni, K. (2010). Factors associated with poor glycemic control among patients with type 2 diabetes. *Journal of Diabetes and its Complications*, *24*(2), 84-89.
13. Powers, M. A., Bardsley, J., Cypress, M., Duker, P., Funnell, M. M., Fischl, A. H., ... & Vivian, E. (2017). Diabetes self-management education and support in type 2 diabetes: a joint position statement of the American Diabetes Association, the American Association of Diabetes Educators, and the Academy of Nutrition and Dietetics. *The Diabetes Educator*, *43*(1), 40-53.
14. Lemon, C. C., Lacey, K., Lohse, B., Hubacher, D. O., Klawitter, B., & Palta, M. (2004). Outcomes monitoring of health, behavior, and quality of life after nutrition intervention in adults with type 2 diabetes. *Journal of the American Dietetic Association*, *104*(12), 1805-1815.
15. Wan, W. M. (2017). Development of sugar craving assessment tool and the application of low caloric sweetener in appetite regulation and eating behaviour (Phd’s thesis, Kuantan, 2017) (pp. 1-264). Kuantan, Pahang: International Islamic University Malaysia
16. Suzana, S., Rafidah, G., Noor Aini, M. Y., Nik Shanita, S., Zahara, A. M., & Shahrul Azman, M. N. (2002). Atlas of food exchanges and portion sizes. *MDC Publishers Printers Sdn Bhd*, *1*, 3-53.
17. Santos, J. R. A. (1999). Cronbach’s alpha: A tool for assessing the reliability of scales. *Journal of extension*, *37*(2), 1-5.
18. Espina, R. M. (2013). Instrument development: Defining the ideas and assessed college teacher. *Proceeding of the Global Summit on Education*, 549-563.
19. Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *psychometrika*, *16*(3), 297-334.
20. Taber, K. S. (2018). The use of Cronbach’s alpha when developing and reporting research instruments in science education. *Research in Science Education*, *48*(6), 1273-1296.
21. Mukaka, M. M. (2012). A guide to appropriate use of correlation coefficient in medical research. *Malawi Medical Journal*, *24*(3), 69-71.
22. Hajian-Tilaki, K. (2013). Receiver operating characteristic (ROC) curve analysis for medical diagnostic test evaluation. *Caspian journal of internal medicine*, *4*(2), 627.
23. Carter, J. V., Pan, J., Rai, S. N., & Galandiuk, S. (2016). ROC-ing along: Evaluation and interpretation of receiver operating characteristic curves. *Surgery*, *159*(6), 1638-1645.
24. CPG, MNT 5th edition, 2015
25. Shahar, S., Earland, J., & Rahman, S. A. (2000). Food intakes and habits of rural elderly Malays. *Asia Pacific Journal of clinical nutrition*, *9*(2), 122-129.
26. Lai, A. E. (2010). The Kopitiam in Singapore: An evolving story about migration and cultural diversity.