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# AWARENESS OF DIABETES MELLITUS AMONG PUBLIC ATTENDING THE PRIMARY HEALTH CENTRES IN MALAYSIA

(Kesedaran Diabetes Melitus dalam Kalangan Orang Ramai yang Menghadiri Pusat-Pusat Kesihatan Utama di Malaysia)

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*ABSTRACT*

Diabetes is a steadily growing problem in Malaysia and the increase of diabetics' patients in Malaysia is worrisome. In relation to this, the purpose of this study is to test Diabetes Mellitus Awareness Model (DMAM) consisting of five constructs, namely knowledge, attitude, environment, symptom and diabetics awareness. This study develops the conceptual model for studying the factors among public in Malaysia in order to possibly increase the awareness towards the ailment. A total of ten hypotheses have been proposed to test the relationship in the hypothesised model between the five constructs under study. Structural equation modelling (SEM) with SmartPLS software using Partial Least Squares estimation (PLS) is used for modelling analysis. The study was conducted in two health clinics, namely Klinik Kesihatan Paya Besar and Klinik Kesihatan Padang Rumbia from 1 September 2015 to 15 October 2015. A total of 550 questionnaires were distributed and 523 questionnaires were successfully collected. From the results, it shows that knowledge on diabetics has a significant impact on a) environment, b) attitude and c) awareness towards diabetics. Next, the environment significantly influences the attitude, and attitude has a significant influence on the awareness. However, the results also show that there is no significant relationship between the environment towards awareness. In addition, both knowledge and environment has no significant effect towards symptoms of diabetes mellitus ailment. The finding also shows that the causal relationship of attitude on symptoms, and the relationship between symptom and awareness are not significant. In conclusion, the healthcare authorities may refer to DMAM as a basis model for increasing the awareness regarding this ailment especially among the public.

*Keywords*: Diabetes Mellitus Awareness Model (DMAM); Structural Equation Modelling (SEM); Partial Least Squares estimation (PLS)

*ABSTRAK*

Diabetes adalah masalah yang terus berkembang di Malaysia dan peningkatan pesakit kencing manis di Malaysia adalah membimbangkan. Lantaran itu, kajian ini bertujuan menguji Model Kesedaran Diabetes Melitus (MKDM) yang terdiri daripada lima konstruk, iaitu *pengetahuan*, *sikap*, *persekitaran*, *gejala* dan *kesedaran* terhadap penyakit kencing manis. Kajian ini membangunkan model konseptual untuk mengkaji faktor-faktor yang mungkin dapat mewujudkan kesedaran dalam kalangan orang ramai di Malaysia agar dapat meningkatkan kesedaran terhadap penyakit tersebut. Sejumlah sepuluh hipotesis telah dicadangkan untuk menguji hubungan antara lima konstruk dalam model tersebut. Pemodelan persamaan struktur (PPS) dengan perisian SmartPLS menggunakan penganggaran Kuasa Dua Terkecil Separa (KDTS) digunakan untuk analisis pemodelan. Kajian ini dijalankan di dua klinik kesihatan, iaitu Klinik Kesihatan Paya Besar dan Klinik Kesihatan Padang Rumbia dari 1 September 2015 hingga 15 Oktober 2015. Sejumlah 550 soal selidik diedarkan dan 523 soal selidik telah berjaya dikumpulkan. Hasil keputusan menunjukkan bahawa *pengetahuan* mempunyai kesan yang signifikan terhadap a) *persekitaran*, b) *sikap* dan c) *kesedaran* terhadap diabetes. Seterusnya, *persekitaran* turut mempengaruhi *sikap*, dan *sikap* mempunyai hubungan yang signifikan terhadap *kesedaran*. Walau bagaimanapun, hasil analisis menunjukkan tiada hubungan yang signifikan antara persekitaran dengan kesedaran. Tambahan pula, kedua-dua pengetahuan dan persekitaran tidak mempunyai kesan yang signifikan terhadap gejala penyakit kencing manis. Dapatan kajian turut mendapati bahawa hubungan bersebab antara

sikap dengan gejala, dan hubungan antara gejala dengan kesedaran adalah tidak signifikan. Kesimpulannya, pihak berkuasa di sektor kesihatan boleh menjadikan MKDM sebagai asas dalam meningkatkan kesedaran terhadap penyakit ini terutamanya dalam kalangan orang ramai.

*Kata kunci*: Model Kesedaran Diabetes Melitus (MKDM); Pemodelan Persamaan Struktur (PPS); Penganggaran Kuasa Dua Terkecil (KDT)

## 1. Introduction

Diabetes mellitus (DM) is a significantly growing public health problem around the world. The World Health Organization (WHO) made a global estimate that there will be 300 million people diagnosed with diabetes by the year 2025 (Gunay *et al.* 2006). The number unfortunately would increase greatly in the developing countries. The Second National Health and Morbidity survey shows that over 3.4 million Malaysian citizens are diagnosed with diabetes in 2010 which takes up approximately 11.8% of the total population in Malaysia, and this figure is projected to increase to 4.5 million by 2020 (Zakaria 2013). Also, it is noted that more young Malaysians are among the victims of diabetics' (Teck-Hong & Farhana 2014).

In fact, diabetes mellitus or commonly known as diabetes is a disease in which the human body does not properly convert food into energy that is needed for daily life. Consequently, a situation occurs where there is an abnormal high sugar (glucose) level in the blood (American Diabetes Association 2012). Diabetes is also a disease that can be attributed to the chronic hyperglycemia, which is the existence of excess glucose in the blood caused by environmental factors and genetic or hereditary (Lim & Liong, 2010).

There are three categories of diabetes i.e. type 1, type 2 and diabetes during pregnancy which is called gestational diabetes mellitus (GDM) (Hashmi *et al*. 2008, Minhat & Hamedon 2014). Type 1 diabetes occurs due to an autoimmune disease, in which the body does not produce any insulin or only produce little insulin, which is essential for regulating blood sugar level (Stahl & Johansson 2009), while Type 2 diabetes is associated with insulin resistance, a condition in which the cells fail to respond properly to insulin (Minhat & Hamedon 2014). Next, GDM usually happens among pregnant women with no previous history of diabetes but high glucose level in the blood (DM Newsletter 2014).

In reality, managing diabetes bears a huge cost in the long term for the patient and also the whole healthcare system and surely yet many people are looking for treatment (Yun *et al*. 2007). In view of this, preventive measures are seen to be among the steps that could save money by reducing the progression of the disease and its further complications. Thus, this situation also shows that there is a need for investigating the factors that influence DM awareness among the public especially in Malaysia. If this is disregarded, low rate of awareness among the public may result in increased risk of diabetes throughout the country.

Many recent studies suggested that there is a lack of public awareness, knowledge, and various factors related to diabetes in many parts of the world (Gunay *et al*. 2006; Murugesan *et al*. 2007). People level of knowledge and perceptions of diabetes is also influenced by family or friends who have history of diabetes. It is believed that individuals with a positive family history of a disease may increase their awareness (Murugesan *et al*. 2007).

Therefore, awareness is a critical deciding factor for early diagnosis, adequate treatment and prevention of complications due to diabetes (Poornima *et al*. 2012). Al-Khawaldeh and Al-Jaradeen (2013) also stated that increasing public awareness on diabetes risk factors through public education is likely to increase awareness on the importance of prevention of diabetes. If this variable of interest is not properly addressed, as a consequence, many young people will live up to an older age, developing and suffering from chronic morbidities and thus leading to a poor quality of life (Raheja *et al*. 2001).

Therefore, this study is exploratory in nature and very important in determining the contributing factors towards increasing the public awareness by proposing the Diabetes Mellitus Awareness Model (DMAM); and to empirically measure the relationships of the determinants of knowledge, attitude, environment and symptoms of the diabetics among public towards the variable of interest i.e. DM awareness in Malaysia as indicated in Figure 1.

## 2. Hypotheses Development

It has been reported that strong association between knowledge and attitude by most studies (Bradley *et al*. 1999; Ng *et al*. 2012). Increased knowledge is a precondition for changing attitudes (Arcury 1990; Rathod *et al*. 2014). A significant relationship was observed between knowledge and attitude, suggesting that most participants who had good knowledge are associated with good attitude and practices accordingly (Ng *et al*. 2012). Thus, knowledge is a critical component of behavioural change (Omobuwa & Alebiosu 2014) and vital in changing the attitude of individual towards diabetes. Therefore, following hypothesis is posited:

$H_1$: There is a positive relationship between knowledge and attitude

Appropriate knowledge promotes environmental literacy among the public who demonstrate the appropriate attitude and behaviour (Moseley 2000). Knowledge which are disseminated to a particular community can give a positive impact towards diabetes like practising healthy lifestyle in order to prevent diabetes from spreading widely. Knowledge about diabetes mellitus should be improved among the general population as some studies have shown that appropriate knowledge of diabetes is effective for good diabetes control of population or community. Thus,

$H_2$: There is a positive relationship between knowledge and environment

In addition, knowledge also could help an individual to detect the symptoms of a disease, particularly diabetes. A good knowledge about diabetes can lead to early diagnosis and improved self-management (Fezeu *et al*. 2010). Knowledge regarding diabetes among relatives is also important because of their increased risk of getting the disease; appropriate knowledge is also necessary to notice the symptoms when they appear and to aid avoidance of risky lifestyles (Van der Sande *et al*. 2001) and through this way, it could also increase the awareness among the public (Amin et al., 2012). Knowledge would expand the individual's general awareness (Arcury 1990) as it could be the basis of establishing diabetes mellitus awareness. Increased knowledge of diabetes in the general population can raise public awareness and improve the detection and control of diabetes (Gunay *et al*. 2006). Based on these statements, following are the propositions to be tested:

$H_3$: There is a positive relationship between knowledge and DM symptoms
$H_4$: There is a positive relationship between knowledge and DM awareness

According to Moritz *et al*. (2014), there is a relationship between positive attitudes and positive symptoms. Similarly, Cooper (2006) found that in a sample of young male students', relationship was observed between eating attitudes and depressive symptoms. In the same vein, a positive attitude would show and lead towards high awareness; as Arcury (1990) also stated that positive public attitudes can increase the public's awareness. Also, studies suggest that individual's attitude are positively associated with the prevention of type 2 diabetes (Al-

Naggar *et al*. 2013). Research conducted by Helgeson (2003) found that the relationship between individual attitude and environment support is linear which indicates that the more the environment support an individual receives, the better is the individual's attitude towards diabetes. There have been many evidences that environment support shows the strongest relationship to an individual attitude. Debono and Cachia (2007) reported a stronger relationship between environment relationships and attitude of diabetic patients. Study done by Ashraff *et al*. (2013) also indicated that the supports from both family and friends have been significantly associated with better attitude. Therefore,

$H_5$: There is a positive relationship between attitude and DM symptoms
$H_6$: There is a positive relationship between attitude and DM awareness
$H_7$: There is a positive relationship between environment and attitude

According to O'Brien *et al*. (2006), there is a positive relationship between environment and symptoms of risk for onset psychosis. This study suggests that positive family involvement can decrease the symptoms of the disease at an early stage. Family and friends could be used as a potential intervention at a very early stage of diabetes mellitus, as family environment plays a key role in the evolution of symptoms of the disease, which would contribute to symptoms reduction and enhanced functional outcomes. Also, having a family history or acquaintances with diabetes is associated with better awareness of diabetes risk factors (Baptiste-Roberts *et al*. 2007). The symptoms could also predict a positive relationship between depressive symptoms and awareness of deficits in dementia (Spitznagel *et al*. 2006). Thus, following hypotheses are developed:

$H_8$: There is a positive relationship between environment and DM symptoms
$H_9$: There is a positive relationship between environment and DM awareness
$H_{10}$: There is positive relationship between DM symptoms and DM awareness

The hypothesised framework for Diabetics Mellitus Awareness Model (DMAM) as in Figure 1 takes into account all important dimensions in determining the factors that could influence DM awareness among the public.

## 3. Methodology

This study which involved the latent constructs and their respective indicators are developed to serve as a guideline to measure respondents' perceptions on knowledge, attitude, environment, symptoms and awareness towards diabetes mellitus among Malaysians. This study adopts cross-sectional design because it ensures representative sampling and minimum response bias (Dabholkar *et al*. 2000). Moreover, the cross-sectional data collection method is considered sufficient for this type of study and is normally used by many researchers (Mostafa 2005).

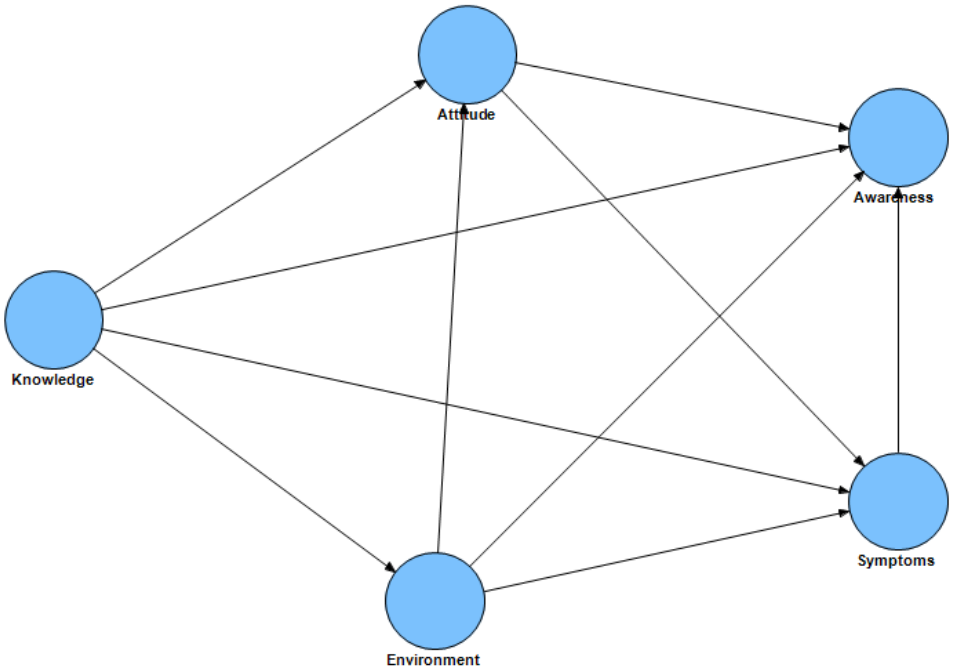


Figure 1: Conceptual framework for Diabetics Mellitus Awareness Model (DMAM)

The survey method with a structured questionnaire was used to draw out specific information from respondents in a sample of population. The reader may enquire from the corresponding author for the questionnaire items for this study. The sample was a convenience sample of adults who attended the outpatient department at Klinik Kesihatan Paya Besar and Klinik Kesihatan Padang Rumbia in Pahang from 1 September 2015 to 15 October 2015. To participate in this study, respondents had to meet inclusion criteria. The criteria: 1) Malaysians, 2) aged 18 years and above, 3) able to read and understand Malay language, and 4) willing to participate in the study.

It is noted that 550 respondents are needed to fulfil the requirement of the number of samples that is suitable for a multivariate statistical analysis. This number of subjects is appropriate with this study that uses a multivariate analysis as suggested by Sekaran (2006). The number of samples also complies with the sampling simulation by Krejcie and Morgan (1970), although this study employs non-probability sampling technique through convenience sampling. The survey uses 5-point Likert scale indicators as follows: scale of 1 (Strongly disagree/Totally unsure), scale of 2 (Disagree/Unsure), scale of 3 (Neutral/I do not know), scale of 4 (Agree/Sure), scale of 5 (Strongly agree/Very sure). Partial least squares structural equation modelling (PLS-SEM) technique using SmartPLS is used to analyse the data in order to achieve the objectives of the study.

## 4. Findings

The questionnaires were distributed to 550 participants of which 523 (95.1%) questionnaires were successfully collected and is considered as very satisfactory. However, out of 523 questionnaires, only 441 questionnaires can be used to proceed with the analysis due to missing values or incomplete responses. Of the 441 respondents, 172 (39%) are males and 269 (61%) are females. Majority of the respondents 426 (96.6%) are Malays and 15 (3.4%)

are Chinese, Indian and others. Only 29 (6.6%) respondents had diabetes, whereas, most of the respondents 412 (93.4%) were non-diabetics. There are 228 respondents (51.7%) who did not have the history of diabetes among their relatives while, 213 (48.3%) of them had.

### 4.1. *The Measurement Model Assessment*

Convergent validity is defined as the degree to which multiple items that measure the same concept are in agreement. According to Hair *et al.* (2010), factor loadings, composite reliability (CR) and average variance extracted (AVE) can be used to assess convergent validity. Table 1 shows the loading of the 22 indicators which are greater than 0.70 as recommended (Chin 1998; Henseler *et al*. 2009). The CR was obtained from the factor loadings of the constructs and its value are obtained from the observed variables that is accounted for by the respective latent variables. From Table 1, all the CR values are in the range of 0.911 to 0.921, which exceeded the recommended value 0.707 and CR values between 0.70 and 0.90 which are reliable (Hair *et al.* 2010).

Table 1: Convergent validity assessment

| Construct | Items | Factor Loading | CR | AVE |
|---|---|---|---|---|
| Attitude | A1 | 0.718 | 0.915 | 0.576 |
| | A2 | 0.706 | | |
| | A3 | 0.746 | | |
| | A4 | 0.774 | | |
| | A5 | 0.755 | | |
| | A6 | 0.766 | | |
| | A7 | 0.779 | | |
| | A8 | 0.820 | | |
| Awareness | AW1 | 0.772 | 0.913 | 0.570 |
| | AW12 | 0.777 | | |
| | AW3 | 0.792 | | |
| | AW4 | 0.846 | | |
| | AW5 | 0.811 | | |
| | AW8 | 0.671 | | |
| Knowledge | Complication | 0.627 | 0.921 | 0.773 |
| | General | 0.720 | | |
| | Prevention | 0.868 | | |
| | Risks | 0.902 | | |
| | Treatment | 0.866 | | |
| Environment | E5 | 0.772 | 0.911 | 0.701 |
| | E6 | 0.790 | | |
| | E9 | 0.845 | | |

*a. Average variance extracted (AVE) = (summation of the square of the factor loadings)/{(summation of the square of factor loadings) + (summation of the error variances)}.*
*b. Composite reliability (CR) = (square of the summation of the factor loadings)/{(square of the summation of the factor loadings) + (square of the summation of the error variances)}.*

After assessing the convergent validity, average variance extracted (AVE) is evaluated which reflects the complete amount of variance in the observed variable accounted for by the latent variable relative to measurement error (Ramayah *et al*. 2013). Again, from Table 1, all AVE values lie between 0.570 and 0.773, which are higher than the minimum recommended value of 0.50 (Barclay *et al*. 1995).

The next step is to test the discriminant validity that refers to "the degree to which items differentiate among constructs or measure distinct concepts", and this is conducted by finding and investigating the associations among the measures of possibly overlapping variables (Ramayah *et al*. 2011). In other words, correlations between the measures of potential overlapping construct provide a mean for assessing the discriminant validity. The AVE for each of the components should be greater than the squares of the correlation between the components and all other components (Christmas 2005). A research model is considered to display good discriminant validity when the correlations among the components is lower than the square root of the AVE (Fornell & Larcker 1981). It can be seen from Table 2 that the correlations for every latent variable are less than the square roots of AVE (shown in bold off-diagonal value).

Table 2: Discriminant validity using Fornell & Larcker (1981)

| | Attitude | Awareness | Environment | Knowledge |
|---|---|---|---|---|
| Attitude | **0.759** | | | |
| Awareness | 0.360 | **0.755** | | |
| Environment | 0.504 | 0.261 | **0.879** | |
| Knowledge | 0.313 | 0.586 | 0.217 | **0.837** |

*Note: Diagonal represents the square root of the AVE, while the off-diagonals represent the correlations among the variables.*

In addition, to establish a more robust result of discriminant validity test, Henseler *et al*. (2012) proposed the use of heterotrait-monotrait ratio of correlations (HTMT). By using simulation studies, the HTMT criterion was shown to have imposed more stringent criteria in order to capture the distinctiveness among the latent constructs. Table 3 shows the results of the HTMT assessment which is obtained from the formula as stated by Henseler *et al*. (2012).

Table 3: HTMT results

| | Attitude | Awareness | Environment | Knowledge |
|---|---|---|---|---|
| Attitude | - | | | |
| Awareness | 0.396 | | | |
| Environment | 0.572 | 0.295 | | |
| Knowledge | 0.349 | 0.653 | 0.244 | - |

The results indicated that there were no discriminant validity problems according to the HTMT criterion. It can be concluded that the latent variables exhibit construct validity which means that they are truly discriminant to each other. This result reinforced the discriminant validity test using Fornell and Larcker criterion. Therefore, the modelling analysis is proceeded to the evaluation of the inner model (structural model).

### 4.2. *The Structural Model Assessment*

The coefficient of determination ($R^2$) of the endogenous latent construct explains the predictive power of the structural model and the effect level of the latent constructs. As a rule of thumb, in marketing research studies, $R^2$ values of 0.75. 0.50 or 0.25 can be described as substantial, moderate, and weak, respectively (Hair *et al*. 2011).

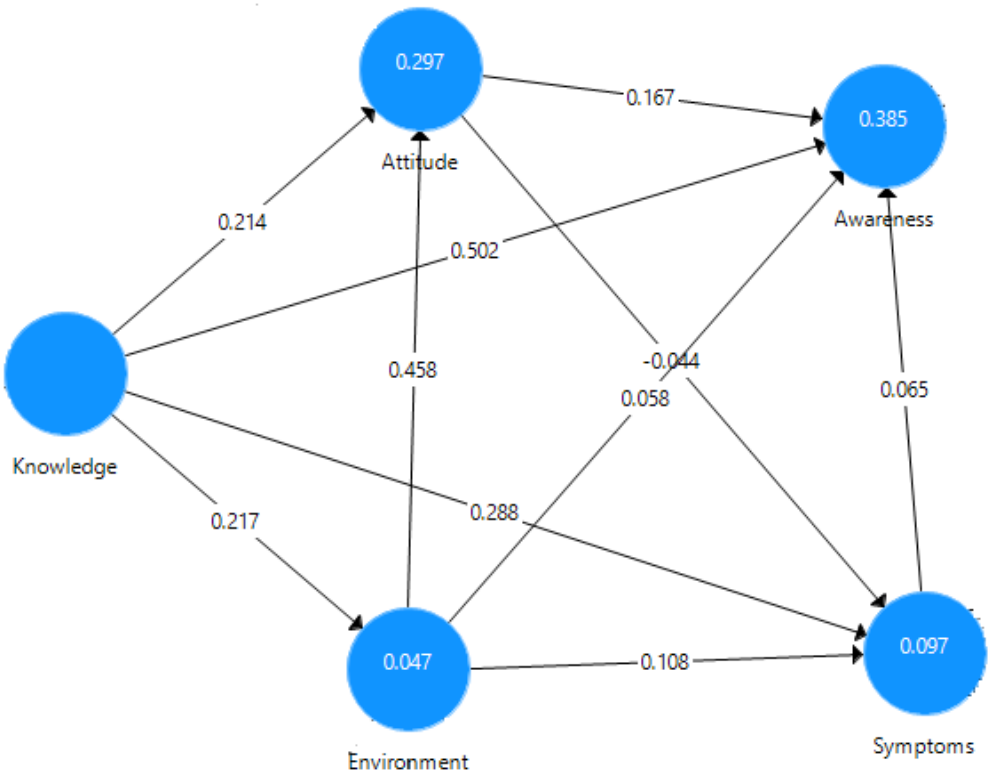


Figure 2: Path analysis for DMAM

As shown in Figure 2, the $R^2$ value for awareness is 0.385, which implies that 38.5% of the variation in awareness is predicted by knowledge, attitude, environment and symptom. Also, the $R^2$ for attitude is 0.297, which means that 29.7% of the variation in this construct is explained by knowledge and environment. Moreover, $R^2$ values of environment and symptoms are relatively weak. Knowledge can only explain 4.7% variation in environment, whereas, knowledge, environment and attitude could only explain 9.7% of variation in symptom. Other than that, the proportion of variance explained by each endogenous constructs from exogenous construct is acceptable.

The ten hypothesised relationships in the structural equation model were tested using partial least squares estimation. The output of the modelling analysis is shown in Table 4. There are relationships that were found to be significant and not significant as indicated in the table. Paths that are significant suggested that hypotheses are supported at 1% level of significance.

Table 4: Hypotheses testing

| Hypothesis | Relationship | Standard Beta | Standard Error | *t*-Statistics | Decision |
|---|---|---|---|---|---|
| H1 | Knowledge -> Attitude | 0.214 | 0.042 | 5.027* | Supported |
| H2 | Knowledge ->Environment | 0.217 | 0.052 | 4.202* | Supported |
| H3 | Knowledge -> Symptoms | 0.288 | 0.299 | 0.963 | Not Supported |
| H4 | Knowledge -> Awareness | 0.502 | 0.044 | 11.503* | Supported |
| H5 | Attitude -> Symptoms | -0.044 | 0.119 | 0.369 | Not Supported |
| H6 | Attitude -> Awareness | 0.167 | 0.051 | 3.267* | Supported |
| H7 | Environment -> Attitude | 0.458 | 0.051 | 9.060* | Supported |
| H8 | Environment -> Symptoms | 0.108 | 0.149 | 0.724 | Not Supported |
| H9 | Environment -> Awareness | 0.058 | 0.046 | 1.270 | Not Supported |
| H10 | Symptoms -> Awareness | 0.065 | 0.094 | 0.693 | Not Supported |

*$p < 0.01$ ($t > 2.33$, one-tailed)

## 5. Discussions of Findings

The study found that there is significant relationship of variable *knowledge* onto: 1) *attitude*, 2) *environment* and 3) *awareness*. It is also found that there is a significant relationship of *attitude* on *awareness*, as well as between *environment* on *attitude*. These significant relationships are vital in gearing up for campaign in fight of diabetes. From the empirically validated Diabetes Mellitus Awareness Model (DMAM), it shows that *knowledge* is clearly influencing the *attitude*, especially in the context of this study. These findings are consistent with studies by Ng et *al*. (2012), who studied the effect of *knowledge* on *attitude* toward diabetes that was conducted in the urban diabetes care centre. On the other hand, *environment* factor could be seen also indirectly impacts the *awareness* of diabetes through *attitude*. This is because the *environment* does not affect directly towards the *awareness* of diabetes. In other words, *awareness* towards diabetes could be instilled by emphasizing on the people *attitude* as the individual's *environment* impacts on their *attitudes* as well. More importantly, *knowledge* factors play an important role in contributing to the overall *awareness* towards diabetes, as it would create a better *attitude* towards a healthier lifestyle.

The study also found positive significant relationship between *knowledge* and the *environment*. A study by Moseley (2000) revealed that the appropriate *knowledge* promotes *environmental* literacy among the public who demonstrated the appropriate *attitude* and behaviour. Next, there is a significant relationship between *knowledge* and *awareness*. This is supported by Arcury (1990) which mentioned that *knowledge* would expand general *awareness* of the people. The study also noted significant direct relationship between *attitude* and *awareness*, indicating that *attitude* affects *awareness*. The findings by Arcury (1990) found that positive public *attitudes* will increase the public's *awareness*. It is also found that the *environment* affects positive *attitude* and this in line with the study by Helgeson (2003) which found that the more *environment* support that an individual receives, the better is the individual's *attitude* towards diabetes. This is evident when someone is surrounded by positive *environment*, it will increase positive *attitude* toward diabetes.

This study found that knowledge does not influence the symptoms of diabetes which concluded that there is no significant relationship between knowledge and symptoms of diabetes. This implied that the knowledge gained could not make someone aware of the symptoms encountered, which may be due to the insufficiency of the knowledge gained. This study also showed that *attitude* does not affect the *symptom*, implying that there is a poor relationship between *attitude* and *symptom*. This finding is in contrast to the views expressed by Moritz *et al*. (2014) who found that there is a positive relationship between *attitude* and psychotic *symptoms*. In addition, this study also found that there is no significant relationship between the *environment* and the *symptom* of diabetes. This is also contrary to the findings by O'Brien *et al*. (2006) who found that positive family involvement could decrease the *symptoms* of the disease at an early stage. This may be caused by the *environment* of family and friends who are less knowledgeable about diabetes, which indirectly could not give support to an individual about the *symptoms* of diabetes.

Furthermore, the study found that the *environment* does not affect the *awareness* of diabetes. These findings also contradict with Baptiste-Roberts *et al*. (2007) who concluded that *awareness* of diabetes risk factor is high when having a family history of diabetes or acquaintances. This may be due to the insensitivity of the individual against the illness of a family member, which causes a lack of *awareness* of the diabetes suffered by family members. The results of the analysis showed that the *symptom* does not affect *awareness*. This is in contrary to that of Spitznagel *et al*. (2006) who found that there is a positive relationship between depressive *symptoms* and *awareness* of deficits in dementia. This may

be due to lack of knowledge about the *symptoms* suffered and does not lead to diabetes *awareness*.

The results of this study, similar to the findings by Al-Khawaldeh and Al-Jaradeen (2013), emphasizes the need for a well-structured educational and awareness program as a primary prevention for the healthy individuals at risk, as well a program for secondary and tertiary prevention for patients with diabetes. Promotion of a healthy diet and involvement in more physical activities at many levels of the societies, such as in the schools, work places and the general public, should be the focus of such programs. Besides that, considerable attention should also be given to the screening programs for persons with undiagnosed diabetes and individuals who have prediabetes.

## 6. Conclusions

In conclusion, greater effort should be made towards establishing primary prevention, health promotion and lifestyle modification through counselling and education in order to cope with the increasing prevalence of diabetes. The current study demonstrates that substantial number of Malaysians lack the sufficient awareness required to prevent and cope with the increasing prevalence of diabetes in Malaysia. The findings highlight the need for a massive health education program on diabetes for the general public. For examples, population-based program for increasing the awareness on the diabetes risk, and active participation of health professionals to communicate the risk information to patients, may help in coping with the increasing prevalence diabetes in Malaysia.

The results of this study are only related to the chosen target sample, which was conducted at two health clinics. Also, the data collected are unable to provide information on the perception of people with diabetes. The findings of those with diabetes are also important in the evaluation of the awareness of diabetes but it cannot be done due to the limitations of time in conducting this study. Furthermore, since the data of this study were collected using a self-reported questionnaire, participants may underestimate or overestimate their perceptions, which might have affected the findings.

The results obtained from this study are of great importance measuring the hypothesised relationships in Diabetes Mellitus Awareness Model (DMAM) and could be used for future improvement program and basis for diabetes awareness assessment in Malaysia.

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