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# Assessment of Physical Inactivity and its Associated Factors Among Type 2 Diabetes Mellitus Patients in a University Primary Clinic in Kuala Lumpur

**Azmawati MN & Siti Norbayah Y**

*Department of Community Health, Faculty of Medicine, Universiti Kebangsaan Malaysia, Cheras, Kuala Lumpur*

## ABSTRACT

**Introduction:** The prevalence of type 2 diabetes mellitus (T2DM) is on the rise in Malaysia. Physical inactivity is common among T2DM patients and is an important aspect that warrants action as it may lead to poor glycemic control. The objective of this cross-sectional study was to assess the prevalence of physical inactivity and its associated factors among T2DM patients. **Methods:** The sample consisted of 121 T2DM patients aged 18 to 65 years who attended the UKMMC primary clinic for routine follow up. A questionnaire consisting of three sections was used to collect the data: (i) socio-economic and diabetes-related factors; (ii) physical inactivity using shortened International Physical Activity Questionnaire (IPAQ); and (iii) five domains leading to physical inactivity. **Results:** The mean age of the sample was found to be 56.2 ± 8.5 years; 55% were physically inactive; 76% had low education; 55.4% had low income; 76% had poor glycemic control; and mean duration of illness was 7.8 ± 6.9 years. Factors significantly associated with physical inactivity were presence of health complications ($\chi^2$ = 5.89; p=0.015) and factor domains of 'respondent's current physical health' (t=5.88, $p$<0.001), 'availability of facility' (t=3.45, p<0.001), 'availability of time' (t=3.57, $p$<0.001) and 'respondent's perception of possibility of sustaining pain and injury during physical activity' (t=3.64, $p$<0.001). Using multiple logistic regression, only factors of 'physical health factor' (Adjusted OR: 1.58, confidence interval 95% (CI 95%): 1.31-1.92, $p$<0.001) and 'time' (adjusted OR: 1.27, CI 95%: 1.12-1.45, $p$<0.001) were found to be associated with higher odds for physical inactivity. **Conclusion:** The results indicate that facility availability, time management and better management of health complications could increase physical activity among T2DM patients.

**Key words:** Physical inactivity, type 2 diabetes

## INTRODUCTION

Prevalence of type 2 diabetes mellitus (T2DM), a non-communicable disease (NCD), has seen an alarming increase globally in Asia and in Malaysia (International Diabetes Foundation, 2013; Chan *et al.*, 2009). T2DM results in high morbidity and mortality through its complications with negative impact to families, communities and nation's economy and productivity (World Health Organization, 2010). T2DM evidence-based management includes patient's self-empowerment of physical activity (Ministry of Health, 2009). Physical activity improves glycemic control and the quality

Correspondence: Azmawati Mohammed Nawi; Email: *atienawi@yahoo.com*

of life among T2DM individuals (American Diabetes Association, 2012; Tan & Magarey, 2008). However, physical inactivity is more common among the T2DM patients (72.5%) compared to the general population (35.7%) in Malaysia (Chew, Khoo & Chia, 2011; Public Health Institute, 2011). Thus, understanding the problems and factors associated with physical inactivity is crucial to planning a concise and holistic management programme for T2DM individuals in Malaysia.

Reasons such as 'lack of time', high cost, unavailability of facilities, 'family commitments' or 'other responsibilities' (e.g. taking care of children) are often cited for physical inactivity on their part (Bovell-Benjamin *et al.*, 2009; Al-Kaabi *et al.*, 2009; Strazdins *et al.*, 2010; Krieger *et al.*, 2009). Health problems commonly occur among T2DM patients such as blurred vision due to uncontrolled blood sugar, lethargy, and unstable feet due to paraesthesia; health problems secondary to diabetes complications are also related to physical inactivity. Problems may also arise from other diseases that may occur concomitantly with T2DM such as joint pain due to osteoarthritis; there is also a persistent fear of sustaining an injury due to the above problems (Huebschmann *et al.*, 2011; Petursdottir, Arnadottir & Halldorsdottir, 2010; Wong, Chan & Lim, 2011).

In Malaysia, there are only a few studies on this topic. Cheah & Poh (2014) studied determinants of participation in physical activity among the general population and found that older individuals, high income earners, females, the well-educated, widowed or divorced individuals, East Malaysians, urban dwellers, the unemployed and individuals who are not diagnosed with hypercholesterolemia (socio-demographic and health factors) are less likely to be physically active than others. A study among T2DM individuals in Malaysia, showed that being elderly, female and having lower education are associated with being physically inactive (Tan & Magarey, 2008). Nor Shazwani *et al.* (2010) also showed that the older age group among T2DM individuals is more prone to physical inactivity. The study also found that lack of time and lack of energy were reasons for being physically inactive. Older individuals face difficulties in performing physical activity. However, it is to be noted that physical activity has been shown to help improve the mental well-being of T2DM patients and the quality of life among those with renal complications (Kaur *et al.*, 2013).

Studies on Malaysian T2DM patients that include assessment of factors associated with physical activity are rather limited. Thus, the present study aimed to determine factors leading to physical inactivity among T2DM patients. We hypothesised that the uptake of physical activity among the T2DM patients is influenced by the availability of facilities and individual social factors such as age and affordability in terms of time and cost. Health problems associated with the disease condition such as presence of co-morbidities also increases physical inactivity among T2DM patients.

## METHODS

This study was conducted in a university primary clinic (UKMMC) in Cheras, Kuala Lumpur city. This clinic provides a comprehensive array of services to the surrounding population, and includes a regular clinic for about 5,500 registered diabetes patients with the gender breakdown being 43.7% males and 56.3% females The ethnicity breakdown of the diabetes patients reflected that of the total general population of Cheras, that is, 40.3% Chinese, 25.4% Malays and 7.6 % Indians.

This cross-sectional study was conducted between March to May 2013 with appropriate ethical approval from the university (UKM 1.5.3.5/244/FF-170-2013) and permission from the managers of the clinic. An interview guided questionnaire

which took about 20 minutes for every application was used. The T2DM patients had a briefing on the details of the study and privacy of the collected data. Only those who agreed to participate, and gave written consent after the briefing were included in the study.

Sampling was done among T2DM patients aged 18 to 65 years who attended the UKMMC primary clinic for routine follow up during the period of the study. Foreigners, pregnant patients and those who had been diagnosed with T2DM for less than 6 months were excluded from the study. The sample size of 121 subjects was calculated using Fleiss (1981) method with 80% power, 95% confidence interval (95% CI) and statistical significance level ($\alpha$) at 5%. An estimated non-response rate of 20% was taken into consideration The sample size calculation was based on the study among the T2DM patients in Arab Saudi by Al-Kaabi *et al.* (2009), where it was reported that physical inactivity was more common among the higher income group.

Data was collected by a trained researcher using a questionnaire consisting of three sections. In the first section, data were collected on demographic, socio-economic and diabetes-related factors. Demographic factors included age, gender and ethnicity, while socio-economic factors included household income, occupation and education level. Diabetes-related factors collected were: (i) duration of diabetes in months to years since first diagnosis; (ii) average of last 6 months of blood HbA1c (glycosylated hemoglobin); (iii) current diabetes treatment; (iv) presence of diabetes complications including other diseases that may affect the respondents' physical ability such as osteoarthritis; and (v) had received and understood advice on physical activity from health care provider. For categorisation of duration of disease, 5 years was used as the demarcation line which is the average duration for developing complications. The average HbA1c was categorised into good control (≤ 6.5 %), moderate control (6.6-8.0 %) and poor control (>8.0 %) (Ministry of Health, 2009).

The second section of the questionnaire involved the assessment of the respondents' current physical inactivity using the shortened version of the International Physical Activity Questionnaire (IPAQ) (IPAQ Research Committee, 2005). A respondent was considered physically inactive if he or she does not fulfill the recommended physical activity for adults aged 18-64 years which is at least 150 minutes of moderate intensity physical activity or 75 minutes of vigorous intensity physical activity or an equivalent combination of moderate and vigorous intensity activity throughout the week (World Health Organisation, 2011).

The third section assessed five domains leading to physical inactivity reported by the respondents (Al-Kaabi *et al.*, 2009; Osborn *et al.*, 2010; Nor Shazwani *et al.*, 2010). The questionnaire was constructed and validated by two experts of the topic, pretested and analysed with factor analysis and reliability testing. All the five domains emerged with a good Cronbach Alpha score for reliability, ranging from 0.715 to 0.989. A suitable title was accordingly given to each domain for easy identification. The domain 'Physical Health factor' assessed physical health factors of the respondent. Does the respondent feel fit to do physical activity or not; 'Availability of facility' referred to availability of appropriate facilities. Were they able to find a place where they could engage in physical activity?; 'Time' was respondents' ability to spend time for physical activity or was their daily schedule too full with other commitments; 'Cost' related to respondents' financial ability to engage in physical activity such as purchasing proper shoes or paying gym fees; and 'Perception of pain/injury' measured the effect of respondent's perceived body pain or 'fear of injury'

sustained from physical activity.

Each of the five domains had a set of related questions which respondents had to score on a Likert scale with 5 scores from 'strongly disagree' to 'strongly agree'. Respondents were asked to identify the scale score that gave them a barrier effect in each domain theme towards engaging in physical activity. The scores were summed up to get the final score ranging from 0 to 8 for each domain. The bigger the score, the higher the barrier effect. The scores were analysed as continuous data.

**Statistical analysis**

The SPSS version 20.0 was used for the statistical analysis. Normality of the data was checked using graphs, box plot and the formal test. Continuous data is presented with mean and standard deviation (SD) with median and interquartile range (IQR) for the not normally distributed data. Categorical data is given in frequencies and percentages. For the bivariate analysis, Chi square test was used to analyse the categorical data. For continuous data, Independent t-test was used while for not normally distributed data the Mann-Whitney U test was used. Pearson correlation assessed the relationship between the barrier factors with Spearman correlation for the not normally distributed data. Multiple logistic regression (MLR) was used to elucidate the various predictor factors leading to physical inactivity. The level of significance was set at a *p*-value of <0.05.

## RESULTS

We approached 130 T2DM patients in the clinic and were able to recruit 121 patients who gave their consent to participate. The majority of the respondents were female (55.4%), aged either in the middle age group (45.5%) or the elderly (43.8%) group (with a mean age of 56), of Malay ethnicity (50.4%), had low level of education (76%) (up to secondary education), low income status (55.4%) (with median income being around RM3000) and were unemployed (47.9%)(Table 1).

In terms of distribution according to disease factors, the majority of the respondents were in the moderate blood sugar control (41.3%) (mean HbA1c of 8.06), did not indulge in physical activity (55.4%), did not have diabetes complications or concomitant diseases that may cause physical inactivity (70.2%) and were mostly treated with only Oral Hypoglycemic Agents (OHA) (67.8%). The mean duration of illness of the respondents was around 8 years and most of the respondents (90.9%) reported that they had received and understood advice regarding physical activity from their doctor or nurse.

No significant differences were noted in the demographic, socio-economic characteristics or the diabetes factors between the respondents who were active or inactive physically (Table 2) except in terms of complications. The percentage of respondents with complications was significantly higher in the physically inactive group ($\chi^2$ = 5.89; p value =0.015; OR= 2.79, confidence interval CI 95%: 1.20 to 6.49).

Among the factor domains, there were significant associations leading to physical inactivity except in the 'Cost' domain (Table 3). For every unit of increase in factor effect in the four domains, there was a significant increase in association with physical inactivity: 'Physical health factor' by 54% (OR: 1.54, CI 95%: 1.27 to 1.87, p<0.001); 'Availability of facility' by 35% (OR:1.35, CI 95%: 1.12 to 1.62, p<0.001); 'Time' by 22% (OR:1.22, CI 95%: 1.08 to 1.38, p<0.001) and 'Perception of fear of pain/injury' domain by 28 % (OR :1.28, CI 95%: 1.11 to 1.48, p <0.001).

The factors associated with physical inactivity assessed using MLR are found in Table 4. It is the final model for predictors of physical inactivity derived from this data where only the barrier domains of 'Physical Health Status' and 'Time'

**Table 1.** Socio-demographic and diabetes factors distribution among the T2DM patients

| *Characteristics* | | *n (%)* | *Mean (SD)* |
|---|---|---|---|
| Gender | Male | | 54 (44.6) |
| | Female | 67 (55.4) | |
| Age (years) | Young (>45) | 13 (10.7) | 56.15 (47.67;64.63) |
| | Middle (45 – 59) | 55 (45.5) | |
| | Elderly (>59) | 53 (43.8) | |
| Ethnicity | Malay | 61 (50.4) | |
| | Chinese | 46 (38.0) | |
| | Indians | 12 (9.9) | |
| | Others | 2 (1.7) | |
| Education [b] | Low | 92 (76.0) | |
| | High | 29 (24.0) | |
| Household income [c] | ≤ 1500 | 22 (18.2) | 3000.00 (2000.00;4900.00) [a] |
| (RM) | 1501 – 3000 | 45 (37.2) | |
| | 3001 – 4500 | 21 (17.4) | |
| | > 4500 | 33 (27.3) | |
| Occupation | Unemployed | 58 (47.9) | |
| | Non-professional | 42 (34.7) | |
| | Professional | 21 (17.4) | |
| HbA1c (mmols/l) | Good ( ≤ 6.5) | 29 (24.0) | 8.06 (5.94;10.18) |
| | Moderate (6.6 – 8.0) | 50 (41.3) | |
| | Poor (> 8.0) | 42 (34.7) | |
| Physical inactivity | No | 54 (44.6) | |
| | Yes | 67 (55.4) | |
| Complications | Yes | 36 (29.8) | |
| | No | 85 (70.2) | |
| Treatment | Diet Only | 2 (1.7) | |
| | OHA | 82 (67.8) | |
| | OHA + insulin | 33 (27.3) | |
| | Insulin only | 4 (3.3) | |
| Duration of Illness | ≤ 5 years | 49 (40.5) | 7.77(0.90;14.64) |
| | > 5 years | 72 (59.5) | |
| Understood HCP | Yes | 110 (90.9) | |
| advice on PA | No | 11 (9.1) | |

*Notes:* n: frequency; %: percentage; SD: standard deviation; [a] median (interquartile range); RM: Ringgit Malaysia; OHA: Oral Hypoglycemic Agents; HCP: Health Care Provider; PA: Physical Activity; [b] Tertiary level and beyond is high level of education. [c] The mean income level for Malaysia in 2012 was RM3000.00;

remained significant. The model has been adjusted for demographic, socio-economic and diabetes factors. It also fulfilled the MLR assumptions: model fitness, no multicolinearity, no interaction and no influential outliers. The overall predicted value was 76.9% with a Nagelkerke value of 0.40 and area under ROC curve value (95% CI) being 0.83 (0.75-0.90). Predicted Model: Probability (Physical inactivity) = 1/ (1+ e-z), where z = -1.708 + 0.460*(Physical health factor) + 0.242*(Time). When using the predicted model, for every scale of both factor domains from 0 (no effect) to 8 (full effect), the range of probability of physical inactivity is from 15.3% to 98.0% among T2DM patients.

## DISCUSSION

Previous studies among T2DM patients have found physical inactivity to be more common among T2DM patients who fell in

**Table 2.** Socio-demographic and diabetes factors by physical inactivity status

| *Characteristics* | | *Physical inactivity* | | *χ2(df)* | *p value* | *Crude OR* | *(95% CI OR)* |
|---|---|---|---|---|---|---|---|
| | | *Yes [b] (n=67)* | *No [a] (n=54)* | | | | |
| Gender: | Male | 30(55.6%) | 24(44.4%) | 0.00(1) | 0.971 | 1.01 | (0.49; 2.08) |
| | Female | 37(55.2%) | 30(44.8%) | | | 1 | |
| Age (years) | Young (>45) | 8(61.5%) | 5(38.5%) | 0.36(2) | 0.835 | 1.43 | (0.41; 4.94) |
| | Middle (45 – 59) | 31(56.4%) | 24(43.6%) | | | 1.15 | (0.54; 2.46) |
| | Elderly (>59) | 28(52.8%) | 25(47.2%) | | | 1 | |
| Race | Malay | 33(54.1%) | 28(45.9%) | 0.08(1) | 0.776 | 1 | |
| | Non-Malay | 34(56.7%) | 26(43.3%) | | | 1.11 | (0.54; 2.27) |
| Education [b] | Low | 49(53.3%) | 43(46.7%) | 0.69(1) | 0.405 | 1 | |
| | High | 18(62.1%) | 11(37.9%) | | | 1.44 | (0.61; 3.38) |
| Household Income c (RM) | Low ≤ 3000 | 40(59.7%) | 27(40.3%) | 1.14(1) | 0.286 | 1.48 | (0.72; 3.05) |
| | High > 3000 | 27(50.0%) | 27(50.0%) | | | 1 | |
| Occupation* | Unemployed | 35(60.3%) | 23(39.7%) | 1.12(1) | 0.291 | 1.47 | (0.72; 3.03) |
| | Employed | 32 (50.8)% | 31(49.2%) | | | 1 | |
| Occupation** | Non-professional | 52(52.0%) | 48(48.0%) | 2.65(1) | 0.103 | 1 | |
| | professional | 15(71.4%) | 6(28.6%) | | | 2.31 | (0.83; 6.43) |
| HbA1c (mmols/l) | Good ( ≤ 6.5) | 19(65.5%) | 10(34.5%) | 1.74(2) | 0.420 | 1.9 | (0.71; 5.04) |
| | Moderate (6.6 – 8.0) | 27(54.0%) | 23(46.0%) | | | 1.17 | (0.52; 2.67) |
| | Poor (> 8.0) | 21(50.0%) | 21(50.0%) | | | 1 | |
| Complications | Yes | 26(72.2%) | 10(27.8%) | 5.89(1) | 0.015 | 2.79 | (1.20; 6.49) |
| | No | 41(48.2%) | 44(51.8%) | | | 1 | |
| Treatment | No insulin | 45(53.6%) | 39(46.4%) | 0.36(1) | 0.548 | 1 | |
| | Insulin | 22(59.5%) | 15(40.5%) | | | 1.27 | (0.58; 2.78) |
| Duration of Illness | ≤ 5 years | 22(44.9%) | 27(55.1%) | 3.66(1) | 0.056 | 1 | |
| | > 5 years | 45(62.5%) | 27(37.5%) | | | 2.04 | (0.98; 4.28) |
| Understood HCP | No | 16(69.6%) | 7(30.4%) | 2.32(1) | 0.128 | 2.11 | (0.80; 5.57) |
| advice on PA | Yes | 51(52.0%) | 47(48.0%) | | | 1 | |

*Notes:* [a] The proportion that is physically active in number (percentage); [b] The proportion that is physically inactive in number (percentage); χ2 (df): chi square value (degree of freedom); RM: Ringgit Malaysia; HCP : Health Care Provider; PA: Physical Activity; Crude OR: Unadjusted Odd Ratio using simple Multiple Logistic Regression; OR CI 95%: OR 95% Confidence Interval.* Occupation assessed according to employed and unemployment; ** Occupation assessed according to professional and non- professional.

**Table 3.** Factors leading to physical inactivity among the T2DM patients in primary clinic

| *Characteristics* | *Physical inactivity in mean (SD)* | | *t (df)* | *p value* | *Crude OR* | *(95%CI OR)* |
|---|---|---|---|---|---|---|
| | *Yes (n=67)* | *No (n=54)* | | | | |
| Physical health factor | 3.98 (1.06; 6.90) | 1.46(-0.28; 3.20) | 5.88(110.44) | <0.001 | 1.54 | (1.27; 1.87) |
| Facility availability | 2.54 (0.24; 4.84) | 1.11 (-1.10; 3.32) | 3.45(119.00) | <0.001 | 1.35 | (1.12; 1.62) |
| Time | 3.86 (0.48; 7.06) | 1.81 (-1.12; 4.74) | 3.57(118.34) | <0.001 | 1.22 | (1.08; 1.38) |
| Cost | 2.00 (0.00; 2.00) [a] | 0.00 (0.00; 2.00) [a] | -2.27 | 0.787 [b] | 1.18 | (0.95; 1.46) |
| Perception of injury/pain | 4.43 (1.73; 7.13) | 2.68 (0.16; 5.20) | 3.64(119.00) | <0.001 | 1.28 | (1.11; 1.48) |

*Notes:* [a] Median (Interquartile Range (IQR)). [b] p value for Mann-Whitney U Test; t (df) : Independent t value (degree of freedom); The higher the mean, the higher the barrier effect; Crude OR: Unadjusted Odds Ratio using simple Multiple Logistic Regression; OR CI 95%: OR 95% Confidence Interval.

**Table 4.** Predicted model of factors associated with physical inactivity

| *Variable* | *B* | *S.E* | *Wald* | *P value* | *OR* | *(95% CI )* |
|---|---|---|---|---|---|---|
| Physical health factor | 0.460 | 0.01 | 22.02 | < 0.001 | 1.58 | (1.31; 1.92) |
| Time | 0.242 | 0.07 | 13.10 | < 0.001 | 1.27 | (1.12; 1.45) |
| Constant | -1.708 | 0.41 | 17.72 | | | |

OR CI 95% : 95% Confidence Interval of OR; SE: Standard Error

the older age groups, were female and had a lower education level (Tan & Magarey, 2008; Public Health Institute, 2011). This study results differ in that physical inactivity was found to be more common in the middle and younger age groups, those with a higher education level and among those in the lower income group. Possible explanations for this finding are that the middle aged and younger groups are more likely to be still be in employment and have other commitments such as family responsibilities as shown by previous studies (Al-Kaabi *et al.*, 2009; Strazdins *et al.*, 2010). Meanwhile those of the lower income group are more likely to be involved in more time consuming employment and tend to get paid on an hourly basis and hence may work longer hours. It, however, failed to show the significance of socio-demographic and economic factors between the physically active and inactive groups. No significant difference was seen in level of physical inactivity between the Malay and non-Malay groups.

As in other studies, physical inactivity is shown in this study to be more common among T2DM patients compared to the general population (Chew *et al.*, 2011; Public Health Institute, 2011). This contradicts the fact that almost all the respondents reported that they had been given advice on physical activity and had understood the importance of the advice. Compared to those without the disease, a previous study has shown that diabetes patients are significantly more knowledgeable about the disease, including treatment and self-management (Yun *et al.*, 2007). Their information sources are mainly their health care providers. Perhaps, there is a need to probe further on the actual nature of the advice and whether they were only given

advice on the benefits of physical activity and the general method of indulging in physical activity. Furthermore, was there any personal advice given on specific problems encountered by a T2DM patient undertaking physical activity? More importantly, can we conclude that because T2DM individuals may have more knowledge of the disease, it will bring about changes in their lifestyle? It could be argued that there are other determinants that contribute to the higher prevalence of physical inactivity among this group compared to the general population. Managing the determinants will ensure greater success in the promotion of a healthy lifestyle among T2DM individuals.

In relation to diabetes factors, those individuals with complications were found to be significantly more physically inactive. In this study, we wish to reiterate that 'complications' refers to any diabetes complications or other diseases that may affect respondents' physical ability such as osteoarthritis. However, it was not possible to determine whether the complications resulted in the respondent being physically inactive or otherwise. The complications of some patients could be due to their physical inactivity resulting in poor disease control. A longitudinal study should explain better the association. However, this observation is not surprising as other studies have also shown that T2DM patients who have complications such as leg ulcers are more likely to be inactive (Huebschmann *et al.*, 2011; Petursdottir *et al.*, 2010; Wong *et al.*, 2011). They are more likely to complain of a lack of energy or experience pain or even just fear the occurrence of pain or sustaining further injury resulting from physical activity. There are, however, many ways to be physically active, and this group of people will surely need and benefit from personal advice on the type of physical activity that they can indulge in, specially tailored to their ability or disability.

Though not found to be significant, those on insulin, with an illness duration of more than 5 years or reported to have not received or understood advice from HCP regarding physical activity also tended to be inactive physically. A qualitative study by Abu Hassan *et al.* (2013) on factors influencing insulin acceptance among T2DM patients found that these patients perceive that being on insulin results in many lifestyle restrictions including physical activity. HCP thus must help to explain to T2DM patients that being on insulin does not restrict lifestyle and they should maintain an active lifestyle despite being on insulin.

Among the five factor domains, 'Perception of fear of pain/injury' was the most frequent domain reported as leading to physical inactivity. This could be attributed to the fact that two-thirds of the respondents were in the elderly group (≥ 60 years group) and could be experiencing complications or concomitant diseases such as osteoarthritis. The three factor domains (physical health factor, availability of facilities and time), that were found to be significantly associated with physical activity status, were also in line with previous studies. Individuals are more likely to indulge in physical activity when he or she feels relatively healthy and fit, when they are able to access nearby facilities and have time and a positive perception.

'Cost' is, however, not reported as a factor leading to physical inactivity in this study. This may be due to the norm of Malaysians to indulge in physical activity in the nearest public facility, if the weather permits; there is no particular emphasis on expensive sports attire. Cost would have emerged as a factor if physical activity is normally done in a proper sports centre where payment of fees would be required for use of the facility. Thus, to promote an active lifestyle among the T2DM individuals, policy makers in Malaysia need to have land use planning policies that ensure availability of public

areas for such activities especially in new townships. These facilities should allow for public access safely at any time of the day. In addition, T2DM individuals need to be given tailored advice on various ways of indulging in physical activities without increasing the risk of injury and experiencing more pain. Most important of all, they need to be given continuous motivation that regular physical activity will make them healthier and fit.

The final prediction model elucidated by the MLR emphasises further the fact that T2DM patients in this study have an erroneous impression that physical activity is not suitable for certain health conditions. Even though not included in the final prediction model, we believe that the presence of complications is interrelated with the factor domain 'Physical health factor'. HCPs and T2DM patients need to be aware that being physically inactive, results in poor glycemic control which can lead to complications. The presence of complications will further aggravate physical inactivity, leading to poor health status.

Sparing time for physical activity is also included in the model. Creating policies to increase the number of public facilities to indulge in physical activity and allowing use of the facility at odd hours of the day such as up to midnight will reduce the 'Time' barriers. It is the HCP's responsibility to aggressively, where appropriate, control the glycemic index to prevent or delay complications through persistent advice in promoting and motivating patients to undertake physical activity. Patients who understand the benefits and are highly motivated will make the time for physical activity.

The model can be used to identify T2DM individuals who are more prone to physical inactivity. Individuals with T2DM can be asked to rate their 'health factor' and 'availability of time for physical activity' on a scale from 0 to 8. Individuals who have a rating nearer to the highest score of 8 will have a higher risk of failure in performing physical activity (approaching 98% chance). Whereas, those whose rating is nearer to the lowest score of 0 will have a lower risk (approaching only a 15% chance). The higher risk group can have specific counseling on physical activity, its benefits, the type of physical activity suitable for specific complications such as renal failure for those on haemodialysis, foot ulcer or other diseases such as osteoarthritis. Regular physical activity has been proven to improve the quality of life in this group of patients (Bennet *et al.*, 2008).

Our study has several limitations. The results of the study may not be generalised or applicable to other settings since it was confined to one primary care centre. As the study was cross-sectional, only association and not the causal effects can be shown. As the study was based on self-report, it is subject to recall bias. This bias also applies when IPAQ is used for physical activity assessment as it depends on self-reporting by respondents. However, as the IPAQ questionnaire is commonly used in Malaysia and many other countries, the use of a common tool should facilitate comparison of findings between different studies. The strengths of this study lies in its ability to show the prevalence of physical inactivity and its associated factors among the local T2DM patients in a primary care centre in Cheras, Kuala Lumpur. The results from this study are useful and relevant to the public health imperative of managing the diabetes epidemic. This study should also serve as a basis for a larger study covering multiple centres to enable a national concise plan or programme to promote healthier behavioral change among the T2DM individuals.

## CONCLUSION

This study has added the call for urgent action in improving beneficial physical

activity among local T2DM patients. It has highlighted that more than half of the T2DM individuals in a primary care setting are physically inactive with this inactivity being positively associated with the presence of diabetes complications or other concomitant diseases such as osteoarthritis. It is also positively associated with factor domains of current health factor, perception of sustaining pain and fear of further injury, and time limitations due to other commitments.

The role of HCPs in health care service needs to be further strengthened. They should be able to provide individually tailored advice and motivation to T2DM patients to better manage their time, suggest ways to be physically active and to better manage complications. Awareness of the fact that physical inactivity is interconnected with DM complications in a vicious cycle should be made known and reinforced. T2DM patients must be educated on the types of physical activity that are suitable to different types of complications. No less important is the role of policymakers to enable better land use planning and availability of facilities for different types of physical activities.

### Conflict of interest

The authors declare no conflict of interest in conducting the study.

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