Original Research

A comprehensive view of knowledge and osteoporosis status among type 2 diabetes mellitus in Malaysia: A cross sectional study

Shaymaa A. ABDULAMEER, Mohanad N. SAHIB, Syed A. SYED SULAIMAN, Mohamed A. HASSALI.
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Abstract

Background: osteoporosis and diabetes mellitus are highly prevalent diseases that have potentially devastating effects on health and socioeconomic status.

Objective: The aims of this study were to assess: 1) the level of osteoporosis knowledge among T2DM patients; 2) the correlation, associations or differences of demographic characteristics, diabetes-related variable, as well as, lipid and blood pressure profiles with osteoporosis knowledge; and 3) the correlation between T-score measurement using quantitative ultrasound scan (QUS) and osteoporosis knowledge.

Methods: A cross-sectional study design was chosen, where data was collected using a self-report structured questionnaire using osteoporosis knowledge - Malay version questionnaire (OKT-M) among T2DM patients. Furthermore, the clinical data regarding the patients were collected retrospectively from the hospital medical record after patient interview was completed.

Results: The average age of the patients was 62.67 (SD 9.24) years (ranged from 33 to 87 years). Males (231, 51.30%) slightly outnumbered females. Among the racial distribution, the proportion of Chinese patients (204, 45.30%) was higher than Malay (127, 28.20%) and Indian patients (119, 26.40%). In addition, more than three quarters (343, 76.20%) of patients had poor glycaemic control. The average OKT-M total score, OKT-M Exercise subscale and OKT-M Calcium subscale were 12.55 (SD 4.06), 8.60 (SD 2.89) and 8.40 (SD 3.36), respectively. Only 33.30% of the T2DM patients were found to have high level of osteoporosis knowledge. There was a lack of identification and recognition of osteoporosis risk factors. There were significant differences or associations between osteoporosis knowledge and education level, monthly income, employment status, family history of fracture, smoking habit, alcoholic status, insulin use, therapy type and diastolic blood pressure. In addition, significant and positive correlations were found between T-scores and OKT-M total score (n=450, rs= 0.244, P=0.000), OKT-M Exercise subscale (n=450, rs= 0.219, P=0.000) and OKT-M Calcium subscale (n=450, rs=0.199, P=0.000) among T2DM patients (all Ps<0.05).

Conclusions: Overall, the study results showed a valuable insight into the knowledge toward osteoporosis, as well as its relation to the bone loss among T2DM patients. It is important to understand the basics of osteoporosis prevention behaviours such as adequate calcium intake and regular exercise which are essential to build and maintain healthy bones throughout life among T2DM.

Keywords

Diabetes Mellitus, Type 2; Osteoporosis; Health Knowledge, Attitudes, Practice; Health Literacy; Risk Factors; Cross-Sectional Studies; Malaysia

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is mounting health problem in the contemporary era, public health concerns with a major contributor to high levels of morbidity and mortality worldwide.[1,2] In Malaysia, a rapidly developing country, continued urbanisation and lifestyle modifications encourage sedentary lifestyles and more overweight and obesity which reflect a pronounced grown in the diabetes prevalence over the past decades.[3,4] Moreover, previous studies showed that poor or suboptimal glycaemic control among diabetic patients were common in Malaysia.[5,6]

On the other hand, osteoporosis is a clinically silent, highly prevalent disease that has potentially devastating effects, which is largely preventable.[7] Globally, osteoporosis is recognised as a common public health issue, especially in postmenopausal women and elderly individuals.[8,9] In addition, osteoporosis in Asian populations is a serious public health problem as Asian ancestry and T2DM are considered risk factors for osteoporosis with low bone mineral density (BMD) compared to other ethnicities.[10-12]

The challenge is to address the lack of knowledge towards the prevention of health behaviours of bone disease which were identified as the most important issues in the management of osteoporosis.[13] Whether, an individual participates in osteoporosis preventative lifestyle behaviours or not, it is essential to have a primary understanding about their knowledge regarding osteoporosis.[14] Subsequently, health educational programmes can be planned and implemented accordingly.

To date, scarce papers have assessed osteoporosis knowledge among T2DM patients, and there is a paucity of literature regarding the relationship between osteoporosis

Shaymaa Abdalwahed ABDULAMEER. PhD. Lecturer. Faculty of Pharmacy, Al-Rafidain University College. Baghdad (Iraq). xbm2004@yahoo.com
Mohanad Naji SAHIB. PhD. Lecturer. Faculty of Pharmacy, Al-Rafidain University College. Baghdad (Iraq). mohanad_pharm@yahoo.com
Syed Azhar SYED SULAIMAN. PhD. Professor. School of Pharmaceutical Sciences, University of Science Malaysia. Pulau Pinang (Malaysia). sazhar@usm.my
Mohamed Azmi Ahmad HASSALI. PhD. Professor. School of Pharmaceutical Sciences, University of Science Malaysia. Pulau Pinang (Malaysia). azmihassali@usm.my

knowledge and quantitative ultrasound scan (QUS) in clinical practice. Hence, the current study were aimed to assess: 1) the osteoporosis knowledge level among T2DM patients; 2) the sources of osteoporosis information among T2DM patients; 3) the correlation, associations and/or differences of demographic characteristics, diabetes-related variable, as well as, lipid and blood pressure (BP) profiles with osteoporosis knowledge; 4) the correlation between T-score measurement using QUS and osteoporosis knowledge.

METHODS

Study design

A study with cross-sectional design was chosen, where data was collected using a self-report structured questionnaire among T2DM patients at Diabetes Outpatient Clinic of Penang General Hospital (PGH), Malaysia (from 1st August 2011 to 30th February 2012). Furthermore, the clinical data were collected retrospectively using the hospital medical records after patient interview was completed.

Study population

The participants were enrolled using convenient sample method with patients eligible criteria: patients diagnosed with T2DM, diabetes duration at least 2 years (for more comprehensive medical records), aged 30 years or over (as the bone mass lose starting in the third decade), able to communicate in Bahasa Malaysia (read and write) and patients willing to participate. The prevalence based sampling technique was used to identify the representative sample of T2DM patients. According to the latest prevalence survey in Malaysian, T2DM prevalence was 14.90%.15 The final convenience sample of 450 patients with T2DM was included in the analysis of this study, which was considered to be acceptable with a margin of error (5%) and 99% confidence interval.

The study was approved by the Medical Research Ethics Committee, National Institute of Health Malaysia (Approval number: [(2) dlm.KKM/NIHSEC/08/0804/P11-101]. All participants were asked to sign the informed written consent form before participate in the study.

Research instruments

A structured questionnaire consisting of three parts was used; this included: (1) personal socio-demographic characteristics questionnaire (about yourself); (2) Osteoporosis Knowledge test Malay version (OKT-M); and (3) diabetes-related data and laboratory test results. All participants were administered a questionnaire before they underwent a QUS examination. For each of the diabetes-related data, laboratory results, blood pressure measurements, BMI were categorised according to the Malaysian Guidelines.[16] A validated OKT-M was used to assess the knowledge toward osteoporosis.[17] Based on the previous validation study of OKT-M, a cut-off point of 14 was used to classified the patients into two groups high and low.[17]

The QUS (SONOST 3000) measurement scores of the calcaneus region was used to calculate a bone mineral density (BMD) status according to the WHO criteria (normal, osteopenia and osteoporosis).[18]

Data analysis

Predictive analytics software (PASW, version 19.0) was used for statistical analysis. The significance level was set at a p-value less than 0.05 for all analyses. Percentages, frequencies and mean plus standard deviation (SD) were presented as required. The chi-square, Mann-Whitney U, Kruskal-Wallis, independent t-test and one-way analysis of variance were conducted when necessary. Pearson and Spearman's correlations coefficient were used to measure the correlations.

RESULTS

In this study, a total of 500 T2DM patients were invited. Patients with incomplete responses (n=19) or missing of clinical data (n=31) were excluded from the analyses. Thus, the final convenience sample of T2DM that included in this study was 450 patients.

The average age of the patients was 62.67± 9.24 years (ranged from 33 to 87 years). Males (231, 51.30%) slightly outnumbered females (219, 48.70%). The majority of patients had an education level less than 12 years (285, 63.30%). The average body mass index (BMI) was 26.36±4.39 kg/m^2, as shown in Table 1. Regarding osteoporosis awareness, only 17.10% of the sample population obtained osteoporosis information from medical clinic.

The mean duration of diabetes of the sample population was 8.65 (SD 5.97) years (range 3-32 years). In addition, more than three quarters (343, 76.20%) of patients had poor glycaemic control, as shown in Table 2. In addition, more than 50% of the patients had poor cholesterol levels, poor LDLC levels and poor control of their systolic blood pressure, as shown in Table 3.

The average OKT-M total score, OKT-M Exercise subscale and OKT-M Calcium subscale were 12.55 (SD 4.06), 8.60 (SD 2.89) and 8.40 (SD 3.36) with correct percentages responses of 52.31%, 53.78% and 49.38%, respectively. Only 33.30% (17; SD 2.01 (16)) of the T2DM patients were found to have high level of OKT-M according to the cut-off point value.

In this study, most participants knew that "eating a diet low in milk products increases the chances of getting osteoporosis" (item one) with 60.40% answering correctly. On the other hand, the OKT-M showed that there were low items scores for: item three "Having big bones decrease your chance of getting osteoporosis", item six "Being a woman of Asian origin increases your chances of getting osteoporosis" and item seven "Having ovaries surgically removed increases your chances of getting osteoporosis" with 22.40%, 45.80% and 34.90% correct answers, respectively. About 54.90% of participants identified that "being menopausal increases the chances of getting osteoporosis" (item two).

The participants (56.40%) recognized that "a diet high in green vegetables can help reduce the chances of getting osteoporosis" (item four). Furthermore, there was a lack of

Table 1. Relationships between osteoporosis knowledge levels and patients' demographic characteristics (N=450)

Variable	N (%)	Osteoporosis knowledge level N (%)		p†	OKT-M scores Mean (SD) [median]	p‡
		Low OKT level	High OKT level			
		300 (66.7%)	150 (33.3%)			
Age (years)**				0.520		0.462
<45	11 (2.4%)	7 (63.6%)	4 (36.4%)		12.82 (4.19) [14]	
45-54	78 (17.3%)	47 (60.3%)	31 (39.7%)		13.19 (3.84) [13]	
55-64	166 (36.9%)	116 (69.9%)	50 (30.1%)		12.40 (3.83) [13]	
≥65	195 (43.3%)	130 (66.7%)	65 (33.3%)		12.41 (4.31) [12]	
Gender*				0.424		0.327
Male	231 (51.3%)	150 (64.9%)	81 (35.1%)		12.75 (3.94) [13]	
Female	219 (48.7%)	150 (68.5%)	69 (31.5%)		12.34 (4.17) [12]	
Race**				0.075		0.068
Malay	127 (28.2%)	75 (59.1%)	52 (40.9%)		13.17 (3.94) [13]	
Chinese	204 (45.3%)	139 (68.1%)	65 (31.9%)		12.17 (4.35) [12]	
Indian	119 (26.4%)	86 (72.3%)	33 (27.7%)		12.55 (3.58 [12]	
Educational levels*				0.000 [a]		0.000 [a]
<12 years	285 (63.3%)	215 (75.4%)	70 (24.6%)		11.76 (3.99) [12]	
≥ 12 years	165 (36.7%)	85 (51.5%)	80 (48.5%)		13.93 (3.80) [14]	
Marital Status*				0.713		0.747
Single	70 (15.6%)	48 (68.6%)	22 (31.4%)		12.69 (3.29) [12]	
Not single	380 (84.4%)	252 (66.3%)	128 (33.7%)		12.53 (4.18) [13]	
Monthly income*				0.000 [a]		0.000 [a]
Less than RM 2000	330 (73.3%)	242 (73.3%)	88 (26.7%)		12.02 (3.81) [12]	
More than RM 2000	120 (26.7%)	58 (48.3%)	62 (51.7%)		14.03 (4.35) [15]	
Menopausal status (N=219)*				0.331		0.737
Premenopausal	25 (11.4%)	15 (60.0%)	10 (40.0%)		12.56 (4.29) [13]	
Postmenopausal	194 (88.6%)	135 (69.6%)	59 (30.4%)		12.31 (4.17) [12]	
Employment status*				0.069		0.022 [a]
Working	192 (42.7%)	119 (62.0%)	73 (38.0%)		13.10 (3.99) [13]	
Not working	258 (57.3%)	181 (70.2%)	77 (29.8%)		12.14 (4.06) [12]	
Family history of osteoporosis*				0.274		0.136
No	392 (87.1%)	265 (67.60%)	127 (32.4%)		12.45 (4.09) [12]	
Yes	58 (12.9%)	35 (60.30%)	23 (39.7%)		13.24 (3.79) [13]	
Family history of fracture*				0.004 [a]		0.007 [a]
No	359 (79.8%)	251 (69.90%)	108 (30.1%)		12.28 (4.17) [12]	
Yes	91 (20.2%)	49 (53.80%)	42 (46.2%)		13.63 (3.39) [13]	
Smoking habit*				0.124		0.028 [a]
Not smoking	318 (70.7%)	219 (68.9%)	99 (31.1%)		12.24 (4.17) [12]	
Smoking	132 (29.3%)	81 (61.4%)	51 (38.6%)		13.30 (3.66) [13]	
Alcohol habit*				0.033 [a]		0.005 [a]
Non alcoholic	356 (79.1%)	246 (69.1%)	110 (30.9%)		12.28 (4.16) [12]	
Alcoholic	94 (20.9%)	54 (57.4%)	40 (42.6%)		13.60 (3.47) [13]	
BMI (Kg/m^2)*				0.374		0.349
Non-obese (BMI ≤23 kg/m^2)	98 (21.8%)	69 (70.4%)	29 (29.6%)		12.32 (4.09) [12]	
Obese (BMI >23kg/m^2)	352 (78.2%)	231 (65.6%)	121 (34.4%)		12.62 (4.05) [13]	

† Association, Chi-square test, [a] p<0.05; ‡ Difference; *Mann-Whitney U test; **Kruskal-Wallis test; [a] p< 0.05
BMI: Body mass index; SD: standard deviation

identification and recognition of the family history of osteoporosis as risk factors for developing osteoporosis with 52.9% correct answers to item five. Similarly, only 39.6% of T2DM were able to recognise that taking cortisone for a long time (item eight) is consider as a risk factor for developing osteoporosis. On the other hand, the most correct answer that assesses the knowledge of risk factors towards osteoporosis was item nine, where 77.3% of participants knew that "regular exercise can help decrease the chances of getting osteoporosis".

T2DM patients showed a varied answer regarding knowledge of exercise toward osteoporosis. Most of the patients identified that running or jogging (item 15) and aerobic dancing (item 16) were the best way to lessen the risk of developing osteoporosis with 70.9% and 66.0%, respectively. However, the response of the participants regarding the other effective way of weight-bearing exercise were low with only 49.6% and 53.8% recognised that walking briskly (item 10) and bicycling (item 11), respectively.

As well as, more than three quarters of T2DM patients (81.8%, item 12) identified that three or more days a week of exercise is required to strengthen bones and more than half of the patients (60.7%, item 13) knew that 20-30 minutes/day should be enough to prevent osteoporosis. In contrast, less than half of the participants (33.1%, item 14) distinguished that breathing should be "much faster, but talking is possible during exercise".

Only 10.2% of participants responded correctly toward the recommended daily calcium intake for adults (item 22). In addition, only 56.2% of the patients responded correctly toward the number of daily servings of milk (item 23). Moreover, most of the patients correctly recognised yoghurt (71.8%) and cheese (64.7%) as good sources of

Table 2. Relationships between osteoporosis knowledge levels and diabetes-related variables (N=450)

Variable	N (%)	Osteoporosis knowledge level N (%)		*p*†	OKT-M scores Mean (SD) [Median]	*p*‡
		Low OKT level 300 (66.7%)	High OKT level 150 (33.3%)			
Diabetes duration (years)**				0.622		0.473
< 5	175 (38.9%)	111 (63.40%)	64 (36.6%)		12.70 (4.03) [13]	
5 – 9	125 (27.8%)	85 (68.0%)	40 (32.0%)		12.68 (3.95) [13]	
10 – 14	89 (19.8%)	60 (67.4%)	29 (32.6%)		12.58 (4.31) [12]	
≥ 15	61 (13.6%)	44 (72.1%)	17 (27.9%)		11.84 (3.98) [12]	
Therapy type*				0.093		0.003[a]
Mono therapy	115 (25.6%)	84 (73.0%)	31 (27.0%)		11.63 (4.32) [11.00]	
Combined therapy	335 (74.4%)	216 (64.5%)	119 (35.5%)		12.87 (3.92) [13]	
Insulin use*				0.190		0.035[a]
With insulin	67 (14.9%)	40 (59.7%)	27 (40.3%)		13.48 (3.93) [13]	
Without insulin	383 (85.1%)	260 (67.9%)	123 (32.1%)		12.39 (4.06) [12]	
Diabetic complication (DC)*				0.175		0.614
Positive (with DC)	330 (73.3%)	226 (68.5%)	104 (31.5%)		12.50 (3.99) [12]	
Negative (without DC)	120 (26.7%)	74 (61.7%)	46 (38.3%)		12.69 (4.23) [13]	
Co-morbidities*				0.656		0.704
Positive (with Co-morbidities)	426 (94.7%)	285 (66.9%)	141 (33.1%)		12.54 (4.09) [12]	
Negative (without Co-morbidities)	24 (5.3%)	15 (62.5%)	9 (37.5%)		12.71 (3.26) [13]	
Glycaemic control (HbA1c)*				0.938		0.801
Good HbA1c (< 6.5)	107 (23.8%)	71 (66.4%)	36 (33.6%)		12.37 (3.81) [13]	
Poor HbA1c (≥ 6.5)	343 (76.2%)	229 (66.8%)	114 (33.2%)		12.61 (4.13) [12]	

† Association, Chi-square test, [a] *P*<0.05
‡ Difference,*Mann-Whitney U test, **Kruskal-Wallis test, [a] *P*<0.05

calcium food (items 20 and 17, respectively). In this study, the patients were correctly recognised the classic calcium sources; but, they were not able to identified canned sardine (54.0%), broccoli (51.8%) and ice cream (29.3%) as alternative sources of calcium (items 18, 19 and 21, respectively). Finally, about 56.90% of participants correctly identified the best reason for taking a calcium supplement (item 24, if a person does not get enough calcium from diet).

There were significant associations between OKT-M levels and education groups, monthly income, family history of fracture and alcoholic habit (p<0.05, Table 1).

Furthermore, significant differences in the OKT-M scores were found between the education groups, monthly income, employment status, family fracture history, smoking and alcohol habit (p<0.05, Table 1).

Moreover, the Spearman's correlation coefficient result between the OKT-M total scores and BMI of the patients was found to be low but significant (n=450, rs=0.13, p<0.05). However, insignificant negative correlation was found between OKT-M total score and age (n=450, r= -0.06, p>0.05).

An insignificant association between the two levels of OKT-M and the diabetes-related variables was found. In addition, significant differences in OKT-M scores were found among insulin use and therapy type (p<0.05) (Table 2). Moreover, an insignificant correlations were found between OKT-M score and diabetes duration in years (n=450, rs= -0.075, p=0.11) and HbA1c (n=450, rs= -0.055, p=0.24). Moreover, a significant difference (p<0.05, Table 3) and correlation (n=450, rs=0.103, p=0.028) were found between the OKT-M scores and diastolic blood pressure (DBP). However, there were insignificant correlations and differences between any of the other collected laboratory values and OKT-M (p>0.05) (Table 3).

The osteoporotic conditions results of the sample population were previously reported.[12] In brief, the average T-score value for the patients was (-1.67; SD 0.83) with (median: -1.65), (range: -3.4 to 1.2) and (CI 95%: -1.75 to -1.59)). The average T-score values of osteoporotic, osteopenic and normal BMD patients' were (-2.76; SD 0.27), (-1.65; SD 0.39) and (-0.41; SD 0.44), respectively. According to QUS measurements, the prevalence of normal BMD (T-scores greater than -1 SD) in this sample population was 18% (n=81), while the prevalence of osteopenia (T-scores between -1 and -2.5 SD) and osteoporosis (T-scores less than -2.5 SD) were considered as 59.8% (n=269) and 22.2% (n=100), respectively.

In this study, significant and positive correlations were found between T-scores and OKT-M total score (n=450, rs=0.244, p<0.001), OKT-M Exercise subscale (n=450, rs=0.219, p<0.001) and OKT-M Calcium subscale (n=450, rs=0.199, p<0.001) among T2DM patients (all p-values<0.05). In short, as osteoporosis knowledge increased, the T-scores increased.

DISCUSSION

Osteoporosis is a significant health problem and poor OKT-M level is a problem requiring urgent attention. This study showed low level of knowledge regarding osteoporosis which consistent with other research.[19] On the other hand, other studies showed that there were high levels of osteoporosis knowledge in their population sample, which was dissimilar to the current observations.[20-22]

Within this sample of T2DM, less than 70% of patients identified that a food low in green leafy vegetables and dairy products increase the chances of getting osteoporosis. In contrast, other studies showed that more than 70% of their participants identified these risk factors.[20,23] Moreover, the patients' knowledge regarding regular physical activity to prevent osteoporosis was good

Table 3. Frequency and percent of lipid profile and blood pressure groups among the studied population (N=450)

Variable	Mean (SD) [Median]	N (%)	OKT-M score Mean (SD) [Median]	p-value
TC	5.25 (0.91) [5.23]			0.439
Good < 5.2 mmol/L		216 (48.0%)	12.41 (4.27) [12]	
Poor ≥ 5.2 mmol/L		234 (52.0%)	12.68 (3.86) [13]	
HDLC	1.19 (0.27) [1.13]			0.219
Good ≥ 1.1 mmol/L		272 (60.4%)	12.40 (4.01) [12]	
Poor < 1.1 mmol/L		178 (39.6%)	12.78 (4.12) [13]	
LDL C	3.06 (0.77) [3.0]			0.614
Good ≤ 2.6 mmol/L		133 (29.6%)	12.70 (4.29) [13]	
Poor > 2.6 mmol/L		317 (70.4%)	12.49 (3.96) [12]	
TG	1.77 (1.06) [1.57]			0.347
Good ≤ 1.7 mmol/L		277 (61.6%)	12.68 (3.96) [13]	
Poor > 1.7 mmol/L		173 (38.4%)	12.35 (4.20) [12]	
SBP	136.48 (8.46) [136.67]			0.283
Good ≤ 130 mmHg		125 (27.8%)	12.82 (3.97) [13]	
Poor > 130 mmHg		325 (72.2%)	12.45 (4.08) [12]	
DBP	81.78 (4.88) [80.0]			0.026 [a]
Good ≤ 80 mmHg		231 (51.3%)	12.13 (3.97) [12]	
Poor > 80 mmHg		219 (48.7%)	13.00 (4.09) [13]	

Mann-Whitney U test, [a]*P*<0.05. TC, total cholesterol; HDLC, high density lipoprotein cholesterol; LDLC, low density lipoprotein cholesterol, TG, triglyceride; SBP, systolic blood pressure; DBP, diastolic blood pressure

which consistent with other studies.[13,23] In contrast, other studies showed low level of knowledge toward exercise.[24,25] The knowledge of genetic risk factors of osteoporosis in T2DM was less convincing which consistent with other studies.[23,26] In contrast, other studies revealed that participants were able to recognise these predisposed risk factors to OP.[13,23] The knowledge regarding changes in life, like being menopausal or having ovaries surgically removed was also low. Similarly, other study showed inadequate knowledge regarding these risk factors.[13] On the other hand, other studies showed that more than three quarters of women knew the risks associated with menopausal status.[20,23] The knowledge about the risk of taking cortisone was inadequately recognised which consistent with other study.[27] In contrast, other studies demonstrated that more than half of the participants were able to recognise this risk factor.[20,23]

More than 50% of T2DM patients gave the correct answer about the best types of exercise for bone health. Similar results were found in other studies.[13,23] However, less than half of T2DM patients knew that walking briskly is good for bone health which was inconsistent with the other studies.[23,28] A systematic review study demonstrated that most of the participants were able to recognise the recommended level with the duration of exercise which was comparable to this study results.[29] In contrast, other study had shown inadequate knowledge regarding exercise intensity.[28]

The participants could identify dairy sources which was consistent with other studies.[13,23] However, non-dairy food sources were less well-known which was similar to other findings.[13,23] It was surprisingly that only 29.3% of T2DM patients recognised that the ice cream is a calcium dietary products which was inconsistent with other studies.[13,23] It was possible that those patients perceived other 'healthier' foods compared to ice cream from diabetic point of view.

In addition, most participants incorrectly identified the recommended amount of calcium intake which was similar to other studies.[13,23]

The results of this study showed insignificant differences and an association between the OKT-M level and patients' age which were consistent with the previous study.30 In contrast, other studies reported positive or negative correlations between osteoporosis knowledge and age.[23,31] It was difficult to explain these distinct differences between the results due to the differences in the study design and instruments used to assess the level of osteoporosis knowledge.

There was an insignificant association and difference between OKT-M level and gender which was similar to other report.[32] On the other hand, other studies demonstrated that women had significantly greater osteoporosis knowledge than men.[33,34] These results were not surprising, as most of the research studies, advertising and public educational programmes focus on osteoporosis in women.

The results indicated that T2DM patients with higher education levels have significantly better knowledge of osteoporosis which was similar to other study.[35] In contrast, study at the community level had shown that educational level was not correlated with osteoporosis knowledge.[36] The reason behind this variation may be attributed to the differences in the cultural backgrounds, level of education, sample size and the types of questions.

A significant differences between OKT-M levels with monthly income and employment status were found which were consistent with other studies.[36,37] This can be explained by the fact that higher incomes enable the individuals to improve their health behaviours. Higher socioeconomic status is known to be associated with better access to healthcare services, healthier lifestyle choices and more easily accessible sports centres.[38]

The results showed a higher level of OKT-M among T2DM patients with a family fracture history. The interpretation of these results should be made with caution as only a 20.2% of the patients had a family fracture history. Moreover, insignificant relationship and difference were found between family history of osteoporosis and OKT-M level

which may be due to the fact that only 12.9% of the participants had a family history of osteoporosis. Similar results was found in another study.[39]

The present study showed diabetic patients who were alcoholic or smokers were found to be more knowledgeable about osteoporosis which was dissimilar to other result.[40] Other study showed that adolescent males scored higher healthy behaviours in avoiding harmful behaviours.[41] However, this may be due to healthcare professionals informing them about the risk factors of these habits on bone health and general health, as well as, diabetic disease.

There were no previous studies addressing the relation between OKT-M and diabetes-related variables. Nevertheless, indirect relations may explain the results. Other studies among T2DM patients showed that poor glycaemic control, long duration of diabetes and treatment type seem to play a key role in decreasing or increase bone mass.[10,12] There was only a significant association and difference in OKT-M score with diastolic blood pressure groups (DBP). A study had proposed a positive relationship between BMD and the presence of hypertension.[42] Furthermore, the cardiovascular risk factors did not appear to influence the BMD among T2DM patients which consistent with other study.[43]

The results showed significant positive correlations between T-scores and both OKT-M and subscales among T2DM patients which consistent with other studies.[26,44] Thus, educational programmes regarding factors such as knowledge, health beliefs, and self-efficacy are of particular importance for integral aspects of health promotion interventions to improve bone health.[14,45-50]

Limitations

As it is not a randomised control study and only targeted outpatients with T2DM in Penang, the results cannot be generlised. Moreover, the final results may be influenced by unequal numbers of gender, ethnic or age groups.

CONCLUSIONS

A low level of osteoporosis knowledge was apparently high regarding some specific elements like risk factors, dietary calcium intake and physical activity. Overall, the present study findings emphasises that there was a significant gap in T2DM patients understanding of osteoporosis and healthy lifestyle behavior. Moreover, the current results discovered the areas of a particular concern for further research to give an additional comprehensive approach to improve the awareness toward osteoporosis. The results of this study are crucial to improve the osteoporosis preventive strategy for high risk populations by developing an effective health educational programme.

CONFLICT OF INTEREST

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