

# Foot care knowledge and self-care practices among diabetic patients in Penang: A primary care study

Ong Jue Jing, MBBS<sup>1</sup>, Siti Sarah Azmil, BM<sup>2</sup>, Kang Cheow Sean, MBBS<sup>3</sup>, Lim Siew Fuen, MD<sup>4</sup>, Ooi Gaik Choo, MBBS<sup>5</sup>, Avni Patel, MBBS<sup>6</sup>, Maliza Mawardi, MFamMed<sup>7</sup>

<sup>1</sup>Klinik Kesihatan Batu Muda, Kementerian Kesihatan Malaysia, <sup>2</sup>Klinik Kesihatan Bayan Baru, Kementerian Kesihatan Malaysia, <sup>3</sup>Klinik Singapore, Jalan Trengganu, Penang, <sup>4</sup>Klinik Kesihatan Jalan Perak, Kementerian Kesihatan Malaysia, <sup>5</sup>Klinik Lim, Jalan Che Ahmad, SPS Nibong Tebal, <sup>6</sup>Klinik Kesihatan Cheras Baru, Kementerian Kesihatan Malaysia <sup>7</sup>Department of Family Medicine, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia

## ABSTRACT

**Introduction:** In Malaysia, the prevalence of diabetes mellitus has been increasing annually, currently affecting 18.3% of the population. Diabetic foot ulcer, a common complication of diabetes, is associated with high morbidity and mortality, consequently increasing health care expenditure. A previous study showed that foot care knowledge and foot self-care practices help to reduce the development of ulcers.<sup>1,2</sup> This study aims to identify the level of foot care knowledge and self-care practices among diabetic patients in the primary care setting. **Objective:** This study was to determine the level of foot care knowledge and foot self-care practices among diabetic patients in the primary care setting in Penang Island and its determinants and the correlation between level of foot care knowledge and self-care practices among diabetic patients.

**Material and Methods:** A cross sectional study was performed on 311 diabetic patients who were registered to two government health clinics in Penang. Information regarding respondents' demographic status, foot care knowledge, and foot self-care practices were gathered using a self-administered questionnaire. Data were analysed using the Statistical Package for the Social Sciences (SPSS) 22. The Mann-Whitney U test and Kruskal-Wallis test were applied to the analysis. Multiple linear regression was performed to identify the determinants. Correlation between knowledge and self-care practice was determined using the linear regression model.

**Results:** One hundred and sixty-five (53.1%) respondents achieved good knowledge scores and 196 respondents (63%) achieved good self-care practice scores. The median age of respondents was 61 years, who were mostly females (56.6%), Malays (41.2%), and unemployed (48.6%). Median HbA1c level was 7.5%, and 42.8% of respondents had diabetes for 5 to 10 years. Lowest scores for knowledge and self-care practices were observed in foot skin care questions. Formal foot care education was found to be a significant predictor of foot care knowledge ( $p < 0.05$ , 95% CI -1.102, -0.098). Foot care knowledge was significantly and positively correlated with foot self-care practices ( $p < 0.001$ , 95% CI 0.548, 0.727).

**Conclusion:** Foot care knowledge has significant positive correlation with foot self-care practices. Empowering diabetic patients with foot care knowledge may lead to significantly better foot self-care practices.

## KEYWORDS:

*Diabetic foot, self-care, primary health care, foot care knowledge*

## INTRODUCTION

According to the National Health Mortality and Morbidity Survey 2019 report, the prevalence of diabetes mellitus among Malaysians has increased from 13.4% in 2015 to 18.3% in 2019.<sup>3</sup> In Penang, the figures are similarly worrying with 18.1% in 2015 and 18.3% in 2019.<sup>3</sup> Diabetic foot ulcer, a common complication of diabetes, is associated with high morbidity and mortality, consequently increasing health care expenditure. Diabetic foot ulcer causes more than 80% of non-traumatic limb amputations and has a 50% mortality rate within 5 years of onset.<sup>4</sup> Overall financial cost of type 2 diabetes mellitus management was recorded to reach RM 1.4 billion in 2011, which corresponded to 9.21% of the Malaysian Ministry of Health's budget.<sup>5</sup> Treatment of an acute diabetic foot infection in a single hospital admission is approximately RM 190 per patient per year.<sup>6</sup>

Studies have shown that diabetic foot care knowledge and foot self-care practices are able to reduce the incidence of diabetic foot ulcers.<sup>1,2</sup> Therefore, foot self-care practices are greatly encouraged to prevent and delay potential complications such as limb amputations.<sup>7,8</sup> Goweda et al. reported that foot self-care practice also reduces common foot problems such as corns and callosities and facilitates the healing of foot ulcers.<sup>7</sup> Despite having profound effects on preventing foot complications, foot care knowledge and foot self-care practices are still inadequate among diabetic patients worldwide.<sup>9,10</sup> A local study in a tertiary centre in Terengganu had reported that patients had substantially poor foot care knowledge and self-care practices.<sup>11</sup> However, no studies had looked into the primary health care centres where majority of the diabetic patients come for their follow-up.

In view of minimal data from primary care facilities, this study aims to determine the level of foot care knowledge and

This article was accepted: 09 February 2022

Corresponding Author: Assoc. Prof. Dr. Maliza Mawardi

Email: maliza\_mawardi@upm.edu.my

foot self-care practices among diabetic patients in primary care, Penang. This study also establishes the factors associated with level of foot care knowledge and foot self-care practices and the correlation between the two.

## MATERIALS AND METHODS

### Study site

Two health clinics in Penang were selected for the study. Both represent the urban population of Penang Island and the largest clinic in each district.

### Subjects and data collection

A cross-sectional study was conducted between August 2019 and February 2020 among diabetic patients attending a public health clinic located in the North-East District and another public health clinic located in the South-West District of Penang Island. Diabetic patients who were 18 years and above, registered with the National Diabetes Registry, and able to understand either English or Malay language were enrolled into the study. Those who were blind, illiterate, pregnant, cognitively impaired, and having debilitating mental illness were excluded from the study.

A validated questionnaire in English developed by Hasnain et al.<sup>12</sup> was adopted to assess the level of foot care knowledge and self-care practices among the respondents. This questionnaire was pre-tested in the study, with further validation done by Almuhanadi et al.<sup>13</sup> and Magbanua et al.<sup>14</sup> via content and face validation. In the local setting, the questionnaire by Hasnain et al.<sup>12</sup> was adopted and validated by Lutfi et al.<sup>11</sup> in Terengganu and Kamaru et al.<sup>15</sup> from UKM Medical centre. The questionnaire was translated from English to Malay language by two independent individuals and back translated to English by a different pair of independent individuals. All were well versed in both languages. Discrepancies in the translation were then discussed to achieve the most suitable and comprehensive Malay language version.

The questionnaire comprises two sections. The first section collected socio-demographic and clinical information of each respondent. These included age, gender, race, occupation, education level, household income, and marital status, whereas the clinical profiles obtained data regarding concomitant medical problems, duration of diabetes, types of medication, glycaemic control, past and current foot abnormalities or complications, and prior exposure to diabetic foot care education. The second section consisted of 15 'yes' or 'no' questions regarding foot care knowledge and foot self-care practices. Each correct answer was given one mark. The points were then added up for each of the foot care knowledge and foot self-care practices categories. Higher scores signified better foot care knowledge and foot self-care practices. The level of good knowledge and good practice was determined based on the median score of each category. Scores greater than the median were considered as good, and scores lower than the median were considered as poor.

A pilot study was conducted on 75 respondents. Reliability analysis showed Cronbach's Alpha value of 0.732 for knowledge score. However, for practice score, the Cronbach's

Alpha value was 0.585. After omitting Item 9 in the practice score questions, Cronbach's Alpha value improved to 0.689. Hence, Item 9 in foot self-care practice was not included in the subsequent analysis. Item 9 in the foot self-care practice questionnaire examines the respondents' habit to change their socks every day. This question might not be relevant in our local context as our community probably does not have the habit of wearing socks due to our tropical climate.

The sample size was determined by assuming that the prevalence of foot care knowledge is 29.3% and prevalence of good diabetic foot practice is 14%, as noted in the reference article by Hasnain et al.<sup>12</sup> Sample size was calculated using G\*Power online application version 3.1.9.2 and a minimum of 310 subjects was required for this study based on 5% significance level and a power of 80% with a 95% confidence interval.

The sample units were recruited using systematic random sampling. A sample interval of 1:10 was derived by dividing the estimated study population with the estimated sample size (3968/372). Diabetic patients who came for follow-up appointments were listed daily to aid in recruitment. The first sample was selected by using a computer-generated random number. Subsequently, every 10th name from the list was approached to be recruited as samples. This went on until the sample size was met.

The researcher approached the selected patients individually and screened them for eligibility. Those who did not fulfil the inclusion criteria or refused to participate were replaced by the following 10th name on the list. Eligible respondents were given verbal and written information regarding the study. After obtaining consent, respondents were required to fill in the questionnaire. Clarification on questions was done only when confusion arose. Respondents' clinical profiles were collected from their medical records. After completing the questionnaire, the respondents underwent a foot examination to identify the presence of diabetic peripheral neuropathy, peripheral arterial disease, diabetic foot ulcers, and other abnormalities. Examination includes inspection for the presence of foot ulcers or deformity, palpation for temperature and pulses, and sensory testing with monofilament and tuning fork.

### Ethical approval

Ethical clearance was obtained from the Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia. This study was also registered under the National Medical Research Register (NMRR ID: NMRR-18-3914-44917).

### Statistical analysis

Statistical Package for Social Sciences (SPSS) software version 22.0 was used for analysis. Normality testing was performed for all continuous data before proceeding to descriptive analysis. The results were reported as median and interquartile range (IQR) as the data were not normally distributed. The Mann-Whitney U test and Kruskal-Wallis test were conducted on categorical variables to ascertain their association with the knowledge and practice scores. The associations between age, duration of diabetes, and HbA1c values with knowledge and practice scores were analysed

Table I: Socio-demographic and clinical background data of respondents

Variable	N (%)	Median (IQR)
Age (in years)		61.0 (14.0)
21–40	23 (7.4)	
41–60	131 (42.1)	
61–80	153 (49.2)	
81–100	4 (1.3)	
Gender		
Male	135 (43.4)	
Female	176 (56.6)	
Race		
Malay	128 (41.2)	
Chinese	117 (37.6)	
Indian	63 (20.3)	
Others	3 (1.0)	
Level of education		
Not schooling	14 (4.5)	
Primary school	72 (23.2)	
Secondary school	179 (57.6)	
College/University	46 (14.8)	
Employment		
Employed	113 (36.3)	
Unemployed	151 (48.6)	
Retired	47 (15.1)	
Hba1c (%)		7.5 (2.4)
<7.0	104 (33.4)	
7.0–8.5	101 (32.5)	
>8.6	97 (31.2)	
Diabetic treatment		
OHA only	223 (71.7)	
OHA and insulin	72 (23.2)	
Insulin only	10 (3.2)	
Diet control	6 (1.9)	
Current foot ulcer		
Yes	9 (2.9)	
No	302 (97.1)	
History of foot ulcer		
Yes	24 (7.7)	
No	287 (92.3)	
Foot deformity		
Yes	10 (3.2)	
No	301 (96.8)	
Diabetic complications		
Retinopathy	36 (11.6)	
Neuropathy	13 (4.2)	
Vasculopathy	38 (12.2)	
None	205 (65.9)	
Others	19 (6.1)	
Formal foot care education		
Yes	170 (54.7)	
No	141 (45.3)	
Duration of diabetes (in years)		8.0 (8.0)
<5	90 (28.9)	
5–10	133 (42.8)	
11–15	47 (15.1)	
>15	41 (13.2)	
Underlying medical problems		
Hypertension	66 (21.2)	
Dyslipidaemia	38 (12.2)	
Hypertension and dyslipidaemia	161 (51.8)	
None	43 (13.8)	
Others	3 (1.0)	

Note. OHA: Oral Hypoglycemic Agent

Table II: Questions determining the foot care knowledge and practice

Foot care measures	Knowledge (N = 311)	Practice (N = 311)
1. Importance of taking anti-diabetic medications to prevent complications	311 (100%)	289 (92.9%)
2. Daily inspection of feet	236 (75.9%)	235 (75.6%)
3. Using warm water for washing/bathing	231 (74.3%)	216 (69.5%)
4. Checking the temperature of the water before using	220 (70.7%)	199 (64.0%)
5. Drying the feet after washing	287 (92.3%)	271 (87.1%)
6. Talcum powder usage for keeping interdigital spaces dry	133 (42.8%)	101 (32.5%)
7. Applying lotion to keep the skin soft to prevent dryness	235 (75.6%)	195 (62.7%)
8. Lotion not to be applied in the interdigital spaces	136 (43.7%)	166 (53.4%)
9. Trimming toenails straight with care	274 (88.1%)	258 (83.0%)
10. Daily washing of feet	304 (97.7%)	298 (95.8%)
11. Wearing comfortable court shoes	276 (88.7%)	297 (95.5%)
12. Checking the inside of the shoes before wearing	283 (91.0%)	277 (89.1%)
13. Not walking barefoot	271 (87.1%)	264 (84.9%)
14. Warning signs for which consultation is required	278 (89.4%)	291 (93.6%)

Table III: Factors associated with levels of diabetic foot care knowledge and foot self-care practice

Item	n	Foot care knowledge score Median (IQR)	p value	Foot care practice score Median (IQR)	p value
Age (in years) <sup>2</sup>			0.485		0.827
21–40	23	10.0 (4.0)		11.0 (3.0)	
41–60	131	12.0 (3.0)		12.0 (3.0)	
61–80	153	12.0 (3.0)		11.0 (3.0)	
81–100	4	12.0 (8.0)		12.0 (6.0)	
Gender <sup>1</sup>			0.490		0.089*
Male	135	12.0 (3.0)		11.0 (3.0)	
Female	176	12.0 (3.0)		12.0 (3.0)	
Race <sup>2</sup>			0.229*		0.021*
Malay	128	12.0 (3.0)		12.0 (3.0)	
Chinese	117	12.0 (4.0)		11.0 (3.0)	
Indian	63	12.0 (3.0)		11.0 (3.0)	
Others	3	13. 13.0 (2.0)		14. 14.0 (.)	
Level of education <sup>2</sup>			0.612		0.314
Not schooling	14	11.5 (6.0)		10.0 (4.0)	
Primary school	72	12.0 (2.0)		12.0 (3.0)	
Secondary school	179	12.0 (3.0)		11.0 (3.0)	
College/University	46	12.0 (3.0)		11.0 (3.0)	
Employment <sup>2</sup>			0.499		0.809
Employed	113	11.0 (3.0)		11.0 (3.0)	
Unemployed	151	12.0 (3.0)		12.0 (3.0)	
Retired	47	12.0 (3.0)		11.0 (3.0)	
Hba1c (%) <sup>2</sup>			0.619		0.336
<7.0	104	12.0 (3.0)		11.0 (3.0)	
7.0–8.5	101	12.0 (3.0)		12.0 (3.0)	
>8.6	97	12.0 (3.0)		11.0 (3.0)	
Diabetic treatment <sup>2</sup>			0.472		0.579
OHA only	223	12.0 (3.0)		11.0 (3.0)	
OHA and insulin	72	11.0 (3.0)		12.0 (3.0)	
Insulin only	10	11.5 (4.0)		11.5 (3.0)	
Diet control	6	12.0 (3.0)		12.0 (2.0)	
Current foot ulcer <sup>1</sup>			0.511		0.897
Yes	9	12.0 (5.0)		10.0 (4.0)	
No	302	12.0 (3.0)		11.0 (3.0)	
History of foot ulcer <sup>1</sup>			0.941		0.226*
Yes	24	11.5 (4.0)		12.0 (3.0)	
No	287	12.0 (3.0)		11.0 (3.0)	
Foot deformity <sup>1</sup>			0.535		0.562
Yes	10	12.0 (5.0)		11.0 (4.0)	
No	301	12.0 (3.0)		11.0 (3.0)	
Diabetic complications <sup>2</sup>			0.356		0.103*
Retinopathy	36	12.0 (2.0)		11.0 (3.0)	
Neuropathy	13	11.0 (5.0)		10.0 (4.0)	
Vasculopathy	38	11.0 (4.0)		10.5 (4.0)	
None	205	12.0 (3.0)		11.0 (3.0)	
Others	19	12.0 (3.0)		11.0 (4.0)	

cont..... pg 228

cont from..... pg 227

**Table III: Factors associated with levels of diabetic foot care knowledge and foot self-care practice**

Item	n	Foot care knowledge score Median (IQR)	p value	Foot care practice score Median (IQR)	p value
Formal foot care education <sup>1</sup>			0.023*		0.004*
Yes	170	12.0 (3.0)		12.0 (3.0)	
No	141	11.0 (2.0)		11.0 (4.0)	
Duration of diabetes (in years) <sup>2</sup>			0.742		0.556
<5	90	11.0 (3.0)		11.0 (3.0)	
5–10	133	12.0 (3.0)		11.0 (3.0)	
11–15	47	12.0 (3.0)		12.0 (3.0)	
>15	41	12.0 (2.0)		12.0 (3.0)	
Underlying medical problems <sup>2</sup>			0.757		0.636
Hypertension	66	12.0 (3.0)		11.0 (3.0)	
Dyslipidaemia	38	11.0 (3.0)		11.0 (4.0)	
Hypertension and dyslipidaemia	161	11.0 (3.0)		12.0 (3.0)	
None	43	11.0 (3.0)		11.0 (4.0)	
Others	3	8. 8.0 (.)		10. 10.0 (.)	

<sup>1</sup>Mann–Whitney test

<sup>2</sup>Kruskal–Wallis test

\* Variables with p<0.25 were selected for multiple linear regression analysis.

**Table IV: Multiple linear regression analysis to determine the predictors of foot care knowledge and self-practice**

Variable	Regression coefficient <i>b</i> (95% CI)	Standardised regression coefficient <i>b</i>	<i>t</i>	<i>p</i>
Foot care knowledge				
Race	- 0.212 (- 0.530 to 0.106)	- 0.074	- 1.312	0.190
Formal foot care education	-0.600 (- 1.102 to - 0.098)	- 0.133	- 2.351	0.019
Foot care self-practice				
Race	0.217 (- 0.041 to 0.474)	0.074	1.656	0.099
Gender	0.271 (- 0.135 to 0.676)	0.058	1.313	0.190
History of foot ulcer	- 0.367 (- 1.125 to 0.391)	- 0.042	- 0.953	0.341
Diabetic complications	0.121 (- 0.070 to 0.312)	0.056	1.244	0.215
Formal foot care education	- 0.333 (- 0.749 to 0.082)	- 0.072	- 1.580	0.115
Foot care knowledge	0.638 (0.548 to 0.727)	0.621	14.001	0.000

using Spearman’s rho. Factors with p<0.25 in bivariate analysis were subsequently analysed with multiple linear regression (MLR). The results of the MLR were presented as coefficient and 95% confidence intervals. Linear regression was performed to determine the correlation between foot care knowledge scores and practice scores. Significant level was set at p<0.05.

**RESULTS**

We approached 332 eligible diabetic patients, of which a total of 311 patients agreed to participate in this study giving a response rate of 93.7%.

Table I describes the sociodemographic data of this study. The median age (IQR) of our study participants was 61 years (IQR 14). Most of them were females (56.6%), Malays (41.2%), and

unemployed (48.6%). Out of 311 patients recruited, 133 (42.8%) had diabetes for 5 to 10 years with the median HbA1c of 7.50% (IQR 2.4).

A large majority of them (71.7%) were using only oral hypoglycaemic drugs, while 26.4% were using insulin either alone or with oral hypoglycaemic drugs. At the time of study, 3.2% of them had foot deformity and 2.9% had ongoing foot ulcer.

In this study, knowledge scores ranged from 3 to 14 with a maximum possible score of 14. The median score was 12.0 (IQR 3), and 165 (53.1%) respondents were categorised as having good knowledge scores. However, for foot self-care practices, the scores ranged from 3 to 14. The median score was 11.0 (IQR 3), with a higher number of respondents (196 respondents, 63%) achieving good practice scores.



Table II shows the responses to questions regarding foot care knowledge and practices. The responses for each foot care measure were generally good with exception for talcum powder usage to keep interdigital spaces dry and avoidance of lotion application in interdigital spaces. The former scored the lowest positive response of 42.8% for knowledge and 32.5% for practice, while the latter scored 43.7% for knowledge and 53.4% for practice. Patients gave a relatively good response to applying lotion to prevent dryness with 75.6% for knowledge, but only 62.7% for practice.

Table III exhibits the median score of both foot care knowledge and foot care practice according to each variable and their strength of association. Race and formal foot care education show p value of less than 0.25 for foot care knowledge score. As for foot care practice score, race, gender, history of foot ulcer, diabetic complications and formal foot care education demonstrate p value of less than 0.25. These variables were further analysed with multiple linear regression analysis.

In this study, there was no multicollinearity between the independent variables in which the tolerance values were more than 0.1 and variance inflation factor (VIF) values were less than 5.

Table IV reports on the predictors for foot care knowledge and self-practice. Formal foot care education was found to be a significant predictor of foot care knowledge ( $p < 0.05$ , 95% CI -1.102, -0.098). Foot care knowledge was seen to be significantly and positively correlated with foot self-care practices ( $p < 0.001$ , 95% CI 0.548, 0.727).

## DISCUSSION

More than half of the respondents achieved good knowledge (53.1%) and good practice (63.0%) scores. This is in line with the percentage of formal foot care education received by the study population where more than half of them (54.7%) were found to have received formal advice on foot care practice in the past. Furthermore, all diabetic patients in primary care settings undergo annual foot examination and counselling by diabetic educator. This has also helped in improving patients' awareness of diabetic foot self-care. Conversely, Lutfi et al.<sup>11</sup> found substantially poor foot care knowledge and foot self-care practices among in-patient respondents, which could be attributed to the fact that their study population was based on a tertiary centre where the respondents were admitted for diabetic foot complication. Hence, it explains the lower knowledge and practice scores among the participants. Interestingly, Kamaru et al.<sup>15</sup> demonstrated a high percentage for good knowledge level (90.1%) but poor scores for practice level (6.2%) among a subset group of elderly patients who attended University Kebangsaan Malaysia Medical Centre (UKMMC). The contrast between the studies may be due to varying implementation of diabetic education programmes. UKM being a teaching hospital would have a more comprehensive screening and education programme for their diabetic patients, thus leading to a higher knowledge score. However, the poor practice of diabetic self-care among the elderly needs to be further explored as our study did not demonstrate age as a significant determinant for self-care practice.

Compliance to medications to prevent complications and foot washing ranked the top scores in assessing respondents' knowledge. All agreed that the importance of taking anti-diabetic medications is to prevent complications. A tertiary centre study in Malaysia observed 93.6% correct responses<sup>11</sup> while in Pakistan, Hasnain et al.<sup>12</sup> reported 78% correct responses regarding importance of taking anti-diabetic medications. This may be due to lack of medical knowledge and awareness because 48.7% of respondents in Hasnain et al.'s<sup>12</sup> study were illiterate. For foot washing, 95.8% respondents in this study knew to wash their feet daily and 92.3% were aware to dry their feet after washing. This was also seen by Lutfi et al.<sup>11</sup> and Magbanua et al.<sup>14</sup> who reported a higher percentage of respondents for both knowledge of daily washing of feet and drying of feet after washing. Several studies conducted in Muslim countries, such as Jeddah, Pakistan, and Makkah, also reported high number of respondents for daily washing of feet, and they are related to the act of ablution performed daily by Muslims.<sup>7,12,16</sup> In this study, 41.2% of respondents are Muslims, and ablution may have played a role in the high percentage of this practice.

Less than half (42.8%) knew about the use of talcum powder to keep interdigital spaces dry, and only 43.7% knew to avoid applying lotion at interdigital spaces. Many other studies observed similar findings as well.<sup>11,12,14,17</sup> This implies that across the Asian countries, little emphasis is placed upon educating diabetic patients regarding foot skin care. Magbanua et al.<sup>14</sup> commented that people of Philippines mostly wear slippers and so the use of talcum powder to keep interdigital spaces dry seemed unimportant. Compared to Lutfi et al.<sup>11</sup> and Magbanua et al.,<sup>14</sup> our respondents scored better in knowledge of foot washing, in terms of checking water temperature (70.7%) and using warm water for washing or bathing (74.3%). Lutfi et al.<sup>11</sup> and Magbanua et al.<sup>14</sup> observed lower scores for knowledge of using warm water for washing at 47.8% and 31.5%, respectively. Magbanua et al. mentioned that water temperature control is largely unavailable in Philippines, and it is a local norm to use tap water without checking the temperature.<sup>14</sup>

As for the practice of foot care, 97.7% of respondents washed their feet daily and a similar attitude was also reported by previous studies.<sup>8,11,12,14</sup> In this study, drying the feet after washing and taking anti-diabetic medications to prevent complications showed lower practice level compared to knowledge level. This reflects poor compliance among the respondents regardless of having good knowledge of foot care. However, a contrary relationship was seen for the behaviour of seeking doctor's consultation. The knowledge of warning signs to seek doctor's consultation was 89.4%, but its practice was higher at 93.6%. This implies that respondents have safe health seeking behaviour.

A low number of respondents (32.5%) were using talcum powder to keep interdigital spaces dry, and slightly more than half (53.4%) of them avoided applying lotion at interdigital spaces. These two items had the lowest percentage for knowledge and practices. Hasnain et al.<sup>12</sup> and Pourkazemi et al.<sup>17</sup> showed even worse responses with a percentage of less than 5% for the practice of using talcum powder to keep interdigital spaces dry. This could be due to the dry and dusty climate in Pakistan (Hasnain et al.) and Iran (Pourkazemi et al.), which makes applying talcum powder to keep toes dry

seemed unimportant. Across the various studies, knowledge and practice of foot skin care are as poor, which is similarly observed in this study. Hence diabetic foot care education needs to emphasise more on methods to maintain healthy skin. For foot washing, our respondents had relatively low scores as only 64% respondents checked water temperature and 69.5% used the correct water temperature. This finding was much better than what was found on the east side of Malaysia.<sup>11</sup> This could be due to the lack of a water temperature control system in the household.

This study has found no significant association between patient's demographic factors with level of foot care knowledge and practice. This could be attributed to the smaller sample size compared to other larger studies that found that level of education, gender, occupation, and age had significant association with respondent's foot care practices.<sup>16-18</sup> Clinical backgrounds such as duration of diabetes, comorbidities, HbA1c, type of diabetic treatment, previous or current foot ulcers, and diabetic complications also did not portray any significant association with foot care knowledge or practice. However, this study observed positive significant correlation between foot care knowledge and foot care practice ( $p < 0.001$ ) as seen by Qadi et al.,<sup>16</sup> Li et al.,<sup>18</sup> and Pourkazemi et al.<sup>17</sup> Furthermore, formal foot care education was also seen as a significant predictor for foot care knowledge ( $p < 0.05$ ). Thus, empowering diabetic patients with concise foot care knowledge will improve their foot care practices.

#### STRENGTHS AND LIMITATIONS

This study was conducted in a primary care setting in Malaysia compared to all previous local studies conducted in a tertiary care setting. It is important to carry out the study in a primary care setting because majority of the community attends primary care clinics for chronic disease follow-up. The sample seen in Lutfi et al.<sup>11</sup> and Kamaru Zaman et al.<sup>15</sup> comprised of inpatients representing diabetics with known complications. This study involved diabetics with and without complications. Hence, this study was able to observe a wider spectrum of diabetic patients. Another advantage was that respondents in this study were randomly selected, which is more representative of the community and eliminates the possibility of bias.

However, few limitations were also observed in this study. Firstly, two demographic factors, income and literacy, were not analysed. Income was enquired in the pilot study but yielded very poor reply from the respondents. Hence, it was omitted during the actual study. Illiteracy was an exclusion criterion, and this was a disadvantage to the study as Hasnain et al.<sup>12</sup> found significant relationship between education level and foot care knowledge, with illiterate respondents exhibiting lowest knowledge scores. Secondly, in the questionnaire, most of the questions were formatted to be marked as correct when replied 'yes' instead of 'no'. Respondents may have realised this and prematurely answered 'yes' for all the questions. Thirdly, the study sample only included urban populations as it was conducted in two primary health care clinics in Penang Island. Semi-urban populations in the mainland of Penang were not included in the study. Therefore, a larger sample inclusive of mainland

and island populations would be a better reflection of the Penang community.

#### RECOMMENDATION

The respondents scarcely use talcum powder and rarely avoid lotion application at interdigital spaces. Their knowledge and practice of foot skin care were quite staggering. The prevailing foot care education lacks foot skin care knowledge; hence, it is recommended that foot care education encompasses methods for sustaining healthy skin of the feet. This study shows that acquiring foot care knowledge significantly improves foot care practices. In view of this notion, further research can be conducted to identify methods of effective foot care education, and audits of current foot care education should be implemented regularly at primary care settings.

#### CONCLUSION

The level of foot care knowledge and foot self-care practice among diabetic patients in the primary care setting in Penang Island is encouraging. This study portrayed a significant positive correlation between foot care knowledge and foot care practices. This proves that acquiring foot care knowledge motivates better foot care practices. Hence, more efforts need to be done to ensure effective delivery of foot care knowledge to all diabetic patients as it leads to a better foot self-care practice, regardless of their socio-demographic and clinical background.

#### ACKNOWLEDGEMENTS

We would like to thank the Director General of Health Malaysia for his permission to publish this article. We also extend our gratitude to all the staff from both the health clinics for assisting us in data collection. We are also grateful to all the patients who have participated in this study. No funding was received for this study.

#### POTENTIAL CONFLICTS OF INTEREST

None.

#### REFERENCES

1. Institute for Public Health. The national health morbidity survey 2019: Non communicable diseases, risk factors & other health problems. Shah Alam: National Institutes of Health 2019 [cited 17 August 2020]. Available from: [http://iku.moh.gov.my/images/IKU/Document/REPORT/NHMS2019/Report\\_NHMS2019-NCD\\_v2.pdf](http://iku.moh.gov.my/images/IKU/Document/REPORT/NHMS2019/Report_NHMS2019-NCD_v2.pdf).
2. National Institute for Health and Care Excellence. Diabetic foot problems: Prevention and management 2015. London: Public Health England 2015 [cited 17 August 2020]. Available from: [www.nice.org.uk/guidance/ng19](http://www.nice.org.uk/guidance/ng19).
3. Mustapha FI, Azmi S, Manaf MR, Hussein Z, Mahir NJ, Ismail F, et al. What are the direct medical costs of managing Type 2 Diabetes mellitus in Malaysia? *Med J Malaysia* 2017; 72(5): 271-7.
4. Lam AWC, Zaim MR, Helmy HH, Ramdhan IMA. Economic Impact of managing acute diabetic foot infection in a tertiary hospital in Malaysia. *Malays Orthop J* 2014; 8: 46-9.

5. Chellan G, Srikumar S, Varma AK, Mangalanandan TS, Sundaram KR, Jayakumar RV, et al. Foot care practice-the key to prevent diabetic foot ulcers in India. *The Foot* 2012; 22(4): 298-302.
6. Calle-Pascual AL, Durán A, Benedi A, Calvo MI, Charro A, Diaz JA, et al. A preventative foot care programme for people with diabetes with different stages of neuropathy. *Diabetes Res Clin Pract* 2002; 57: 111-7.
7. Goweda R, Shatla M, Alzaidi Arwa, Alzaidi Arij, Aldhawani B, Alharbi H, et al. Assessment of knowledge and practices of diabetic patients regarding diabetic foot care in Makkah, Saudi Arabia. *J Fam Med Health Care* 2017; 3(1): 17-22.
8. International Working Group on the Diabetic Foot. International consensus and practical guidelines on the management and prevention of the diabetic foot 2007 [cited 17 August 2020]. Available from: [www.iwgdf.org](http://www.iwgdf.org).
9. Desalu OO, Salawu FK, Jimoh AK, Adekoya AO, Busari OA, Olokoba AB. Diabetic foot care: Self reported knowledge and practice among patients attending three tertiary hospitals in Nigeria. *Ghana Med J* 2011; 45(2): 60-5.
10. García-Morales E, Lázaro-Martínez JL, Martínez-Hernández D, Aragón-Sánchez J, Beneit-Montesinos JV, González-Jurado MA. Impact of diabetic foot related complications on the health related quality of life of patients: A regional study in Spain. *Int J Low Extrem Wounds* 2011; 10: 6-11.
11. Lutfi ARM, Zaraihah MR, Ramdhan IMA. Knowledge and practice of diabetic foot care in an in-patient setting at a tertiary medical center. *Malays Orthop J* 2014; 8(3): 22-6.
12. Hasnain S, Sheikh NH. Knowledge and practices regarding foot care in diabetic patients visiting diabetic clinic in Jinnah Hospital, Lahore. *J Pak Med Assoc* 2009; 59(10): 687-90.
13. Almuhanadi S, Board A, Board I, Alsuliti M, Alhennawy H. Assessment of diabetic patients' knowledge and comorbidities. *Bahrain Med Bull* 2017; 39.
14. Magbanua E, Lim-Alba R. Knowledge and practice of diabetic foot care in patients with diabetes at Chinese General Hospital and Medical Center. *J ASEAN Fed Endocr Soc* 2017; 32(2): 123-31.
15. Kamaru Zaman NH, Mohd Shah NS, Hussein SZ. Knowledge and practice of foot care among diabetic elderly in UKM Medical Centre. *The Malaysian Journal of Nursing* 2018; 9(3): 6-12.
16. Qadi MA, Al Zahrani HA. Foot care knowledge and practice among diabetic patients attending primary health care centers in Jeddah City. *J King Abdul Aziz Univ Med Sci* 2011; 18(2): 55-71.
17. Pourkazemi A, Ghanbani A, Khojamli M, Balo H, Hemmati H, Jafaryparvar Z, et al. Diabetic foot care: Knowledge and practice. *BMC Endocrine* 2020; 20: 40.
18. Li R, Yuan L, Gao XH, Lou QQ, Zhou F, Shen L. The current status of foot self care knowledge, behaviours and analysis of influencing factors in patients with type 2 diabetes mellitus in China. *Int J Nurs Sci* 2014; 1(3)266-71.