Quality of Diabetic Foot Care in Muscat, Oman

Ibrahim Al-Busaidi

A thesis submitted for the degree of Bachelor of Medical Science with Honours at the University of Otago, Dunedin, New Zealand

Edgar National Centre for Diabetes and Obesity Research, Department of Medicine

Dunedin School of Medicine
2013
ABSTRACT

Background

Diabetes mellitus is a common and increasingly important chronic disease worldwide. In Oman, the setting of this thesis, the prevalence of diabetes was 12.3% in 2008. Diabetes causes substantial morbidity and mortality, with diabetic foot disease (DFD) being one of the most serious and costly complications of diabetes. Good preventive foot care measures, patient and provider education and adherence to proper foot self-care practices can reduce the risk of developing DFD by up to 85.0%. No published study has investigated diabetic foot care in Oman.

Objectives

The aim of this study was to explore the quality of diabetic foot care provided by primary and secondary health care professionals in an area of Muscat, Oman. The specific objectives were: 1) To ascertain the level of foot self-care amongst people with diabetes; 2) To determine the level of foot care education for people with diabetes provided by primary and secondary health care professionals; 3) To determine the level of professional foot care services provided to people with diabetes; and 4) To examine the association between foot self-care practices and known risk factors for diabetes-related foot disease (DRFD).
Methods

The study setting was eight primary health care clinics and one polyclinic in Alseeb, Muscat, Oman. A convenience sample of 350 Omani patients with diabetes (310 from primary health care and 40 from the polyclinic) were invited to participate in the study. A questionnaire developed from two pre-existing questionnaires and pre-tested and translated into Arabic, was administered by author of this thesis and research assistants. The questionnaire included six domains including demographic details, patient-reported DRFD, foot self-care, foot care education, and professional foot care. Data were checked, entered into Excel spreadsheet, and analysed using STATA Statistical Software version 12.0 (2012). Proportions and means were calculated as appropriate for variables of interest. To examine the association between dependent and independent variables, a one-way analysis of variance was used for categorical variables and product-moment correlation test for continuous variables. Ethical approval was obtained from the Medical Research and Ethics Review Committee, Ministry of Health, Oman.

Results

Of the 350 participants, 62.3% were female and more than half of the patients were illiterate (52.9%). DRFD was found to be common in this population with more than 55.0% of the study population reported having at least one or more sensory peripheral neuropathy symptoms, and almost half (49.1%) complained of one or more peripheral vascular disease symptoms in the last month. In spite of this, patients often did not adopt all recommended behavioural foot care practices. For example, 54.7% did not look at the bottoms of their feet daily, 58.4% reported using moisturising creams or lotions between their toes daily, and 46.0% reported wearing traditional Omani sandals which do not offer protection from injuries.

Fewer than half of the participants reported receiving advice or information on recommended foot care practices from their diabetes health care professionals.
Professional diabetes foot care services were suboptimal. For example, 20.4% of participants reported never being asked about numbness in their feet and 21.7% reported having been seen by a podiatrist during the previous year. In the final model, a statistically significant association was found between foot self-care scores and level of formal education, diabetes treatment and professional foot care.

**Conclusions and recommendations**

Despite the presence of DRFD in this Omani population with diabetes, the overall quality of diabetic foot care was suboptimal. From the patient perspective there is a need for high quality diabetic foot care education to improve patients’ foot care awareness and self-management. Patient education requires good communication skills and an understanding of patients’ education levels, and the influence of cultural, social and religious practices. A multidisciplinary team approach and ongoing foot care education for health care professionals is needed in order to improve their diabetic foot care knowledge and skills.

To better understand the context, barriers to regular recommended foot self-care practices needs to be explored further, and the reasons for non-adherence to the Omani diabetes foot care guidelines by health care professionals requires further clarification. Nevertheless, findings from this study will be useful for health care planners and policy makers in Oman and neighbouring countries with similar health systems for improving the overall quality of diabetes foot care.
PUBLICATIONS AND PRESENTATIONS

ACKNOWLEDGEMENTS

“Seldom are life’s achievements the result of solitary effort - rather they are the culmination of effective team-work.”  

(Pettit, 1999)

I wish, first and foremost, to thank my wonderful supervisors, Dr Kirsten Coppell from the Edgar National Centre for Diabetes and Obesity Research (ENCDOR) and Dr Nadia Abdulhadi from the Department of Researches and Studies, Ministry of Health, Muscat, Sultanate of Oman, for their proper guidance, continuous support and excellent supervision.

I would also like to express my greatest gratitude and appreciation to Associate Professor Sheila Williams, from the Department of Preventive and Social Medicine, for her continuous statistical assistance at all stages of the project.

Special thanks to the staff at ENCDOR and the Department of Medicine for their encouragement, good advice and help with the technical issues. Exceptional thanks to Professor Jim Mann for his valuable comments, encouragement and support. My sincere thanks go to the BMedSc (HONS) students at the Department of Medicine. Thanks for your support and valuable advice. I wish you all the best.

I am extremely thankful to many people in Oman and New Zealand who contributed to the success of this piece of research: the Scholarships committee at the Ministry of Higher Education in Oman for approving the project; the staff members at Alseeb Directorate of Health Services; the heads and staff of the included health facilities in this study; the health care professionals who participated in reviewing the content and the structure of the study questionnaire; assistant professor Abdulla Al-Hinaei from Sultan Qaboos University, College of Education, Islamic Studies, for revising the translated version
of the questionnaire; and members of Community Support Group (CSG) for their appreciated help in data collection.

Above all, I would like to thank the Omani patients who so willingly gave their time and volunteered for this project. Without your participation this study would not have been possible. I am so grateful for your generosity.

Last, but not least, I would like to thank my immediate and extended family and friends, especially Julia Vendeland, for their tremendous support, patience while in Oman and New Zealand. This thesis is for a better Oman.
# TABLE OF CONTENTS

ABSTRACT .............................................................................................................................................II

PUBLICATIONS AND PRESENTATIONS .............................................................................................V

ACKNOWLEDGEMENTS .....................................................................................................................VI

TABLE OF CONTENTS .......................................................................................................................VIII

LIST OF TABLES ...................................................................................................................................XII

LIST OF FIGURES ...............................................................................................................................XIV

LIST OF ABBREVIATIONS ..................................................................................................................XV

1.0 INTRODUCTION ............................................................................................................................1

1.1 BACKGROUND ...............................................................................................................................5

1.1.1 Country profile ........................................................................................................................5

1.1.2 Culture, religion, and health care in Oman .............................................................................7

1.1.3 The health care system ..........................................................................................................9

1.1.4 Organisation of health services ............................................................................................9

1.1.4.1 Primary health care .......................................................................................................10

1.1.4.2 Secondary and tertiary health care .............................................................................11

2.0 LITERATURE REVIEW ..................................................................................................................12

2.1 DIABETES IN OMAN ...................................................................................................................12

2.1.1 The burden of diabetes .......................................................................................................12

2.1.2 Rising burden of diabetes risk factors ................................................................................14

2.1.3 Diabetes care .......................................................................................................................14

2.1.3.1 Configuration of diabetes services ............................................................................14

2.1.3.1 Diabetes guidelines .......................................................................................................15
2.2 DIABETIC FOOT DISEASE: A PUBLIC HEALTH CHALLENGE ................................................................. 16
  2.2.1 Pathogenesis of DFD .................................................................................................................. 16
    2.2.1.1 Risk factors and causal sequence for lower limb ulceration ............................................. 16
    2.2.1.2 The pathway to lower limb amputation .......................................................................... 17
  2.2.1.3 Prognosis ............................................................................................................................... 17
  2.2.2 Epidemiology of DFD and lower limb amputation ................................................................. 18
  2.2.3 Costs of lower limb ulceration and amputation ...................................................................... 19

2.3 PREVENTION AND MANAGEMENT OF DFD .......................................................................... 20
  2.3.1 Screening and risk stratification ............................................................................................... 21
    2.3.1.1 Screening ............................................................................................................................. 21
    2.3.1.2 Risk stratification ................................................................................................................. 22
  2.3.2 Structured interventions in diabetic foot care .......................................................................... 23
    2.3.2.1 Multidisciplinary approach ................................................................................................. 24
    2.3.2.2 Educational interventions: Patient, caregiver, and health professional education 25

2.4 QUALITY OF FOOT CARE AMONGST PEOPLE WITH DIABETES ............................................. 27
  2.4.1 Evaluation of the quality of diabetic foot care ......................................................................... 27
  2.4.2 Initiatives to improve the quality of foot care .......................................................................... 28
    2.4.2.1 Financial incentives: pay for performance ......................................................................... 29
    2.4.2.2 Clinical practice Guidelines ............................................................................................... 30
    2.4.2.3 Diabetes registers .................................................................................................................. 30

2.5 RATIONALE OF THE STUDY ....................................................................................................... 32

2.6 STUDY AIM AND OBJECTIVES ..................................................................................................... 33

3.0 METHODS........................................................................................................................................ 34
  3.1 STUDY DESIGN ............................................................................................................................... 34
  3.2 ETHICS APPROVAL ....................................................................................................................... 34
  3.3 STUDY SETTING .............................................................................................................................. 35
    3.3.1 Primary Health Care Centres ................................................................................................. 36
    3.3.2 Polyclinics ............................................................................................................................... 36
3.4 Patients

3.5 Sample size

3.6 Questionnaire

3.6.1 The development of the Diabetic Foot Disease and Foot Care Questionnaire (DFDFC-Q)

3.6.1.1 Survey pre-tests

3.6.1.2 English pre-test

3.6.1.3 Expert review of the DFDFC-Q

3.6.1.4 Translation into Arabic

3.6.1.5 Arabic pre-test

3.7 Data Collection

3.7.1 Interviewers

3.7.2 Recruitment of participants

3.7.3 Completion of the questionnaires

3.8 Data Management

3.9 Statistical Analysis

3.9.1 Foot self-care score

3.9.2 Professional foot care education score and provision of professional foot care score

3.9.3 Predictors of foot care score

4.0 Results

4.1 Participation

4.1.1 Characteristics of participants

4.2 Self-reported foot problems

4.3 Foot self-care

4.3.1 Foot self-care performance

4.3.2 Foot self-care scores

4.4 Footwear

4.5 Foot care education by health care professionals
LIST OF TABLES

Table 1: Prevalence of diabetes mellitus, impaired glucose tolerance, and impaired fasting glucose in Oman according to World Health Organisation 1985 or 1999 diagnostic criteria

Table 2: Levels of care in the management of DFD

Table 3: The number of registered diabetes patients in health care centres in Alseeb at the first quarter of 2010

Table 4: The response rate for each participating health clinic

Table 5: The socio-demographic characteristics of the participants who attended the primary health care centres or the polyclinic. Data are percentages

Table 6: The clinical diabetes-related characteristics of the study population attending the primary health care centres or polyclinic. Data are percentages unless otherwise stated

Table 7: The proportion of patients with diabetes reporting symptoms of sensory peripheral neuropathy and peripheral vascular disease in the last month

Table 8: Patient-reported diagnosis of sensory peripheral neuropathy and peripheral vascular disease in the last month

Table 9: The proportion of patients who reported doing or having an assistant do the different recommended foot self-care practices and the frequency of these practices

Table 10: The type of shoes worn by patients

Table 11: The choice of sockwear worn by participants

Table 12: The proportion of patients who reported receiving foot care education about the different items from health professionals

Table 13: The proportion of patients who reported having the different professional foot care practices undertaken during the last year and the frequency with which they were done

Table 14: Relationship between socio-economic, diabetes, and foot characteristics and foot self-care behaviours
Table 15: Simple linear regression of predictors of foot self-care scores

64
LIST OF FIGURES

Figure 1: Estimates and projections of the global number of people with diabetes from 1980 to 2011. ............................................................... 2

Figure 2: The Sultanate of Oman. .......................................................... 5

Figure 3: Distribution of the population of the Sultanate of Oman according to the General Census of Population, Housing and Establishments 2010. ......................................................... 6

Figure 4: Health system network in the Sultanate of Oman. ........................................... 10

Figure 5: The number of diabetes and non-diabetes related lower extremity amputations performed in the Ministry of Health institutions in Oman, 2002–2010. ................................................. 19

Figure 6: Diagrammatic distribution of the Oman’s MoH health institutions in Muscat Governorate on December 31, 2010. ................................................................................. 35

Figure 7: Methodological steps used for the development and pre-testing of the DFDFC-Q42

Figure 8: The number of patients with each of the possible foot self-care scores (n = 350). The maximum possible score was 48. ................................................................. 55

Figure 9: The number of patients with each of the possible foot care education scores (n = 342). Maximum possible score was 14. ................................................................. 58

Figure 10: The number of patients with each of the attained professional foot care scores (n = 338). Maximum score was 18. ................................................................. 60
# LIST OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANOVA</td>
<td>Analysis of Variance</td>
</tr>
<tr>
<td>APC</td>
<td>Alseeb Polyclinic</td>
</tr>
<tr>
<td>BMI</td>
<td>Body Mass Index</td>
</tr>
<tr>
<td>CI</td>
<td>Confidence Interval</td>
</tr>
<tr>
<td>CPGs</td>
<td>Clinical Practice Guidelines</td>
</tr>
<tr>
<td>CSG</td>
<td>Community Support Group</td>
</tr>
<tr>
<td>DALYs</td>
<td>Disability-adjusted Life Years</td>
</tr>
<tr>
<td>DCs</td>
<td>Diabetic clinics</td>
</tr>
<tr>
<td>DFD</td>
<td>Diabetic Foot Disease</td>
</tr>
<tr>
<td>DRFD</td>
<td>Diabetes-related Foot Disease</td>
</tr>
<tr>
<td>HbA$_{1c}$</td>
<td>Haemoglobin A$_{1c}$</td>
</tr>
<tr>
<td>IDF</td>
<td>International Diabetes Federation</td>
</tr>
<tr>
<td>IFG</td>
<td>Impaired Fasting Glucose</td>
</tr>
<tr>
<td>IGT</td>
<td>Impaired Glucose Tolerance</td>
</tr>
<tr>
<td>IWGDF</td>
<td>International Working Group on the Diabetic Foot</td>
</tr>
<tr>
<td>MoH</td>
<td>Ministry of Health</td>
</tr>
<tr>
<td>NDR</td>
<td>National Diabetes Registry</td>
</tr>
<tr>
<td>NZ</td>
<td>New Zealand</td>
</tr>
<tr>
<td>ODR</td>
<td>Otago Diabetes Register</td>
</tr>
<tr>
<td>OGTT</td>
<td>Oral Glucose Tolerance Test</td>
</tr>
<tr>
<td>PHCCs</td>
<td>Primary Health Care Centres</td>
</tr>
<tr>
<td>PN</td>
<td>Peripheral Neuropathy</td>
</tr>
<tr>
<td>PVD</td>
<td>Peripheral Vascular Disease</td>
</tr>
<tr>
<td>QIs</td>
<td>Quality Indicators</td>
</tr>
<tr>
<td>QOF</td>
<td>Quality and Outcome Network</td>
</tr>
<tr>
<td>RSE</td>
<td>Robust Standard Error</td>
</tr>
<tr>
<td>SD</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>SPN</td>
<td>Sensory Peripheral Neuropathy</td>
</tr>
</tbody>
</table>

Wilayat in the Arabic language refer to districts, the singular is Willayah
1.0 INTRODUCTION

Diabetes mellitus is a chronic non-communicable disease of growing worldwide significance. Globally, the prevalence of diabetes mellitus has reached an alarming proportion [1], and recently has been described as a ‘pandemic’ [2]. Despite using different methodologies, prevalence studies have clearly demonstrated that the number of people with diagnosed diabetes is rising globally [1, 3-6]. In 2011, the overall (diagnosed and undiagnosed) prevalence of diabetes worldwide amongst adults aged 20-79 years was estimated to be 8.3%, affecting 366 million individuals. It is predicted to increase to 9.9%, or 552 million adults by 2030 [7]. Figure 1 presents global estimates and projections of the prevalence of diabetes over the past 15 years [7].

The Sultanate of Oman, the setting of this study, is one of the Gulf Cooperation Council countries, and has been recently classified as a high income country according to the World Bank classification [8]. Oman is amongst the countries with the highest prevalence of diabetes in the world [9]. During the past two decades a marked increase in the prevalence of diabetes has been observed in Oman with an increase from 10.0% in 1991 [10] to 13.4% in 2010, which meant Oman had the eighth highest prevalence of diabetes in the world [9].
One of the most debilitating complications of diabetes is diabetic foot disease (DFD). Diabetic ulceration and its long-term sequelae including infections, gangrene and osteomyelitis are the leading causes of lower extremity amputations [11, 12]. Lower extremity amputations are at least ten times more common in people with diabetes than in non-diabetic individuals [13]. Diabetes-related foot disease (DRFD) accounts for approximately 40-60% of all non-traumatic lower extremity amputations worldwide, but is as high as 70-90% in some regions of the USA [14, 15].
Good preventive foot care measures, patient education and foot self-care can reduce the risk of developing DRFD by 49-85% [16]. However, adherence to recommended foot self-care activities can be influenced by several factors, including socio-demographic factors, clinician adherence to diabetes foot examination guidelines, and patient foot care education [17]. Good patient education leads to improvement in both foot care knowledge and foot care behaviours, and may result in fewer clinical manifestations of diabetes-related lower limb disease [14, 18, 19]. Moreover, primary care health professional diabetes education has been found to be associated with an overall improvement in clinical practice behaviours [20], significantly increased clinician adherence to foot examination guidelines [21, 22], and lead to a reduction in lower extremity ulcerations and amputations amongst patients with diabetes, when combined with other preventive measures [20, 23].

Monitoring and evaluating the quality of foot care amongst patients with diabetes at both regional and national levels is of the utmost importance for identifying gaps in foot care and promoting processes that maintain healthy feet, and detect and treat risk factors early [14]. A search of the published and grey literature did not find any information on the quality of diabetes-related foot care in Oman. Most existing published studies and reports described the overall quality of diabetes care in Oman, but did not assess the quality of diabetic foot care [24-26].

The aim of this study was to explore the quality of foot care amongst patients with diabetes in selected primary and secondary care facilities in Muscat, Oman. A patient survey was undertaken and the quality of foot care was evaluated by assessing three quality indicators: basic professional foot care, foot care education, and foot self-care.

The chapters of this thesis are organised as follows: chapter one gives an overview of the thesis and background information on Oman’s health system. Chapter two provides a review of the literature on the global and national burden of diabetes and its risk factors and DFD - the epidemiology, pathogenesis, cost and recommended prevention and management clinical guidelines. Chapter three describes the study methods including the design, setting, participants, data collection and tools of the study. Chapter four presents the results of the study. In chapter five, the key results are summarised, possible
explanations for the study findings are discussed, comparisons are made with other studies, and the strengths and limitations of the study are presented. The final chapter provides the study conclusions and recommendations for improvements in diabetes foot care in the primary care clinical setting and possible directions for future research.
1.1 Background

1.1.1 Country profile

The Sultanate of Oman (from here will be referred to as Oman) is located in south-western Asia in the extreme south eastern corner of the Arabian Peninsula. It borders the Arabian Sea, the Arabian Gulf (Persian Gulf), the Gulf of Oman [27], the Kingdom of Saudi Arabia, the United Arab Emirates and the Republic of Yemen (Figure 2).

![Figure 2: The Sultanate of Oman](image)

During most days of the year, the weather in Oman is hot and dry. The country is composed of varying topographic areas consisting of plains, dry river beds (wadis) and
mountains. The mountains occupy almost 15.0% of the total land area of Oman, with the remainder being mainly wadis and desert [27].

The population of Oman is 2.8 million of which 29.4% are non-Omanis [27]. About 28.0% of the total population live in Muscat, the capital of Oman. The country is administratively divided into five regions and four governorates, two of which are subdivided into two for health administration purposes, resulting in 11 health regions [30]. The population of each of the nine regions and governorates is shown in figure 3 [28].

![Distribution of the population of the Sultanate of Oman according to the General Census of Population, Housing and Establishments 2010](image)

**Figure 3**: Distribution of the population of the Sultanate of Oman according to the General Census of Population, Housing and Establishments 2010

Note: Figure adapted from Ministry of National Economy, 2010 [28] and Ministry of Education, 2011 [29]

In 2010, life expectancy at birth was estimated to be 70.8 and 76.2 years, for men and women, respectively. Overall, the Omani population is young, with 12.7% of the population aged under 5 years, 34.3% aged under 15 years, and 3.8% aged 60 years and over [30].
Prior to the discovery of oil in 1964, agriculture and fisheries were Oman’s main sources of income and the country lacked basic infrastructures, transportation systems, and education. Since then, due to political commitment and oil revenues, the country has been modernised through the establishment of modern infrastructures, a health care system, and educational programmes [31]. Oman is heavily dependent on oil and gas exports which constitute about 80.0% of government revenues. The country continues to grow economically, and in 2010, the Gross National Income per capita was estimated to be around 19,260 US dollars [32].

Economic prosperity has enabled all Omani men and women to enjoy the right to free education delivered through basic school education, and vocational and higher education. The illiteracy rate has declined markedly over the past four decades, but is still high, particularly amongst women. According to the 2003 general census, the national adult literacy rate had reached 78.0% (71.0% for women and 85.0% for men) [33].

In spite of developments in each of the economic, health, and social domains, the Omani government is still facing challenges related to literacy and labour force [27]. For instance, the literacy rate is lower than the national average for Omanis in some regions, particularly the rural areas. Moreover, a significant proportion of the Omani labour force is still unemployed (13.0%), 74.0% of which are aged 15 to 24 years [34].

1.1.2 Culture, religion, and health care in Oman

Factors as diverse as religion, local culture and weather can have a significant impact on patients’ health beliefs and behaviours, and, in turn, outcomes of health interventions. Furthermore, health risks are perceived differently according to different cultural values and norms. Understanding the influence of such factors on public health is of great significance to health workers for disease prevention and health promotion, and therefore must be taken into account [35].
The vast majority of Omani individuals embrace the religion of Islam as their faith. Muslims are generally forbidden to drink or consume anything harmful to health, such as alcohol, illicit drugs and tobacco. However, it is worth noting that some Muslims participate in such harmful activities.

The importance of the palm date fruit in Oman has cultural, religious and economic roots. Islam also provides the fruit with a special significance. Dates, of which more than 80.0% of the total nutritional content is sugars [36], are a popular snack, often consumed many times a day with or without Omani coffee. At religious festivals, such as Eid and Ramadhan, and at weddings, the consumption of dates is typically higher than usual, which can be unsuitable for patients with diabetes [36].

Henna, a brown or black dye that is used to temporarily colour parts of the skin (upper and lower limbs), hair and finger nails, is widely used amongst Omani men and women. It is typically used amongst women as a cosmetic in religious and cultural festivals.

Traditional medicine still plays a major role in health and disease in Oman. There is a strong belief amongst Omanis about the curative ability of traditional medicine. Several types of treatments are used in traditional medicine, such as herbal medicines, cautery and blood-letting. Such practices can have complications and can delay patients seeking conventional medicine from primary health care providers [37].
1.1.3 The health care system

In the early 1970s the government realised the significance of health in social and economic growth, and the Ministry of Health (MoH) was established to lead the development process of a health system in Oman [38].

Health care in Oman is provided predominately by the public sector through 226 health care institutions (176 health care centres and 50 hospitals) scattered throughout the country [30]. Health care costs for all Omani public sector employees and unemployed are covered by the government. For non-nationals and their dependents (29.4% of the Omani population), health care costs are covered by their employers as mandated by the Omani law [34]. In 2010, total health care expenditure as a percentage of total government expenditure was 5.1% [30].

1.1.4 Organisation of health services

The MoH is the principal provider of public health-related services in Oman. The MoH shoulders the responsibility of ensuring the availability and implementation of health policies and plans [39]. In addition to the MoH, health care is provided by other governmental and non-governmental bodies, principally the private sector. The overall structure of the public health system in Oman is illustrated in figure 4 [39].

The health care system managed by the MoH operates at three levels: primary, secondary and tertiary health care. Clinics and hospitals managed by agencies other than the MoH are linked to the Ministry of Health system through a referral chain pathway [30].
1.1.4.1 **Primary health care**

Primary health care is regarded as the main entry point for most patients including those with diabetes, and is provided through primary health care centres (PHCCs). PHCCs deliver outpatient health services for people living in defined catchment areas. Most health care centres are equipped with on-site diagnostic facilities, such as laboratory, radiology services, dental care, and a pharmacy. A few PHCCs located in remote areas also have beds for short inpatient services. Speciality clinics for diabetes, hypertension and communicable diseases, as well as general conditions, are undertaken in all PHCCs. Patients with conditions that require higher level of attention are referred to specialised secondary care clinics or hospitals.
1.1.4.2  Secondary and tertiary health care

Secondary health care is provided through polyclinics and regional hospitals scattered throughout the country. Polyclinics provide specialised secondary care in a number of speciality areas through outpatient clinics [30]. Secondary health care is also offered through a number of regional and wilayat (district level) hospitals. These hospitals provide most inpatient and outpatient speciality services as well as ambulatory services. The majority of regional hospitals are built in close proximity to polyclinics. Tertiary health care is only provided through national referral (regional) hospitals in the Muscat Governorate [30].


2.0 LITERATURE REVIEW

Diabetes is a group of metabolic conditions that can result in long-term microvascular and macrovascular damage, leading to retinopathy, nephropathy, neuropathy, peripheral vascular disease, cerebrovascular disease and ischaemic heart disease. Both nerve and blood vessel damage in the lower limbs can lead to diabetic foot disease (DFD).

2.1 Diabetes in Oman

2.1.1 The burden of diabetes

The disease pattern in Oman is moving rapidly from infectious diseases to chronic non-communicable diseases that are typical of the Western lifestyle [40]. Diabetes poses an enormous challenge to Oman's economy and health system [10, 40, 41]. The prevalence of diabetes has increased over the past four decades, and is now amongst the highest in the world [42]. Table 1 summarises data from various successive national health surveys conducted during the past two decades.

The first National Diabetes Survey to estimate the burden of diabetes and other cardiovascular risk factors was conducted in 1991 [10]. It demonstrated that about 10.0% of the Omani population aged 20 years and above had diabetes. The 2000 National Health Survey found that 11.8% of men and 11.3% of women aged 20 years and above had diabetes [43]. In 2008 the Oman Health Survey showed a further increase in the prevalence of diabetes, reaching 12.3%, while the prevalence of impaired fasting glucose was 4.4% [44]. Furthermore, the fourth edition of the Diabetes Atlas issued in 2009 by the International Diabetes Federation (IDF) estimated a 96.7% increase in the number of Omanis living with diabetes between 2010 and 2030, from 180,000 to about 354,000 [42].
Table 1: Prevalence of diabetes mellitus, impaired glucose tolerance, and impaired fasting glucose in Oman according to World Health Organisation 1985 or 1999 diagnostic criteria

<table>
<thead>
<tr>
<th>Survey, year</th>
<th>Method used</th>
<th>Age group studied (Years)</th>
<th>DM</th>
<th>IGT</th>
<th>IFG</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Diabetes Survey, 1991</td>
<td>A 2-hour post glucose load using OGTT</td>
<td>≥ 20</td>
<td>10</td>
<td>10</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Fasting plasma glucose</td>
<td>≥ 20</td>
<td>8.3</td>
<td>NA</td>
<td>5.7</td>
</tr>
<tr>
<td>National Health Survey, 2000</td>
<td>Fasting plasma glucose</td>
<td>≥ 20</td>
<td>11.6</td>
<td>NA</td>
<td>6.1</td>
</tr>
<tr>
<td>Oman Health Survey, 2008</td>
<td>Fasting plasma glucose</td>
<td>≥ 18</td>
<td>12.3</td>
<td>NA</td>
<td>4.4</td>
</tr>
</tbody>
</table>

Abbreviations: DM - diabetes mellitus, IGT - impaired glucose tolerance, IFG - impaired fasting glucose, OGTT - oral glucose tolerance test, NA - not applicable (since fasting plasma samples were used)

The establishment of the National Diabetes Registry (NDR) in 1999 by the MoH allowed the number of cases of diabetes to be systematically tracked in Oman. By the end of 2005, the number of diabetes cases registered on the Omani NDR was 48,972, of which 4,862 were new cases of diabetes registered during 2005. Nearly 97.0% had type 2 diabetes while the remainder had type 1. The two health regions with the highest numbers of new diabetes cases were in North AlBatinah with 1,055 individuals and Muscat Governorate with 1,028 individuals [45]. By 2010, the total number of people with diabetes enrolled on the NDR had increased to 66,702, which was a 36.0% increase from 48,972 in 2005 [30, 45]. Of the 5,574 new cases in 2010, about 80.0% were aged between 20 and 59 years [30]. This is the working and, probably, the most productive age group.
2.1.2 Rising burden of diabetes risk factors

Known diabetes risk factors include age, family history of diabetes, obesity, hypertension, dyslipidaemia, alcohol and cigarette smoking. The two most important risk factors are obesity and age, with obesity being a significant contributor to the current diabetes epidemic in Oman [44, 46].

The prevalence of overweight and obesity is high in Oman and has been increasing at a drastic rate [46]. In 1991, the age-standardised prevalence of overweight, defined as a Body Mass Index (BMI) = 25-29.9 kg/m², was approximately 29.0%, and the prevalence of obesity, defined as a BMI = ≥ 30 kg/m², was 19.0% amongst adults aged 20 years and over. In 2000, the prevalence of overweight was similar (30.4%), but the prevalence of obesity had increased to 25.5% [46].

With respect to other risk factors, in 2001 more than 24.0% of those aged 20 years and over had abdominal obesity, about 21.0% had high triglyceride levels, and 75.0% had low high-density lipoprotein. [47]. Overall, the age-adjusted prevalence of the metabolic syndrome amongst Omanis was 21.0% (23.0% amongst women and 19.5% amongst men) [47]. In 2000, about 7.0% of those aged 20 years and over were current smokers, and a further 2.3% were former smokers [48]. In 2003, a cross-sectional school-based study found that over 27.0% of boys and about 9.0% of girls aged 13-15 years used any form of tobacco products [49].

2.1.3 Diabetes care

2.1.3.1 Configuration of diabetes services

The control of diabetes is one of the priority health programmes in Oman [50]. It is coordinated by the Department of Surveillance and Non-communicable Disease Control in the Directorate General of Health Affairs in the MoH [50]. Initially the diabetes control
programme focused on the provision of trained primary health care physicians capable of managing chronic diseases, developing and providing quality health education for patients with diabetes, and conducting diabetes public awareness campaigns [10]. The next step was to appoint diabetologists in several regional focal points. They are known as "focal diabetologists", and are responsible for the diabetes management training and supervision of all primary health care physicians in their respective areas.

At present, diabetes care is mainly delivered in PHCCs, where patients with non-complicated cases are followed and monitored closely every two to three months. PHCCs have specific days for scheduled diabetes clinics each week. Patients are routinely seen by a primary health care physician and a practice nurse specialising in diabetes. Patients may also see a dietitian and health educators, if they have been referred to them by their doctor. Patients with poorly controlled diabetes are referred to secondary or tertiary care facilities according to the urgency and seriousness of their condition [50].

2.1.3.1 Diabetes guidelines

In order to integrate and improve the quality of diabetes care in Oman, the MoH developed detailed guidelines for the management of diabetes in primary health care facilities in 1996. The guidelines were updated in 2003, and a further update was launched in October 2012 [50].

The manual describes in detail the responsibilities of each member of the diabetes care team (doctor, diabetes nurse, dietitian/diet technician, and health educator). All members of the diabetes team are encouraged to work together in synchronisation in the process of diabetic care delivery [51]. There is also a separate guideline for diabetes foot care management [52]. These guidelines provide recommendations for the screening and management of diabetes-related complications in primary care [50].
2.2 Diabetic foot disease: A public health challenge

“It is time for health care planners and health care professionals to turn their attention to a condition that is a source of major morbidity and mortality, and that often afflicts those who are least able to cope. Someone, somewhere, loses a leg because of diabetes every 30 s of every day. To reduce this burden of disability by even a small amount would represent a major advance.” [53]

Diabetic foot disease (DFD) can be defined as a group of heterogeneous conditions of foot abnormalities, in which peripheral neuropathy (PN) and peripheral vascular disease (PVD), sometimes complicated by infection, may result in foot ulceration and possible subsequent amputation [54]. DFD is one of the most debilitating complications of diabetes [53]. It causes enormous personal, societal, medical and economic cost [12]. Despite this, DFD continues to be neglected by health care services in some countries [53].

2.2.1 Pathogenesis of DFD

2.2.1.1 Risk factors and causal sequence for lower limb ulceration

The pathogenesis of ulceration in diabetes is complex and probably multifactorial [55-59]. A combination of contributory causes work together in an interplay leading eventually to ulceration in patients with diabetes [60]. Some of the important factors pertinent to the development of foot ulcers include PN, PVD, minor trauma and peripheral oedema [55]. A joint prospective study from the UK and North America concluded that the most critical triad of factors for the development of lower extremity ulcers were neuropathy, minor foot trauma and structural deformity [57]. Other factors associated with increased risk for lower extremity ulceration are previous amputation [61], previous ulceration [58], loss of protective sensation, visual impairment [62], inadequate patient education and self-care
practices [63], male sex [64], poor glycaemic control defined as glycosylated haemoglobin A\textsubscript{1c} (HbA\textsubscript{1c}) >9.0\% [65, 66], smoking and excess alcohol consumption [61].

2.2.1.2 The pathway to lower limb amputation

Of all amputations performed in people with diabetes, foot ulceration has been found to be a precursor in more than 85.0\% of cases [12, 14, 23, 61]. A prospective study from the US [56] examined the causal pathway leading to lower limb amputation in 80 male veterans with diabetes, and found the causal sequence began with minor trauma, followed by cutaneous ulceration and wound-healing failure in 72.0\% of all amputations [56].

2.2.1.3 Prognosis

The prognosis for diabetes-related foot disease is generally poor [67-69]. After undergoing a lower limb amputation, the five-year risk of a subsequent amputation of the same or opposite extremity is as high as 50.0\% [61], and three-year survival is reported to be as low as approximately 50.0\% [59], which is worse than for most malignant cancers [23].
2.2.2 Epidemiology of DFD and lower limb amputation

During their lifetime, people with diabetes have an overall cumulative risk of up to 25.0% for developing an active non-healing foot ulcer [23, 70, 71]. Patients with diabetes who have had a previous ulcer have a 50.0% risk of developing another ulcer within three years [72]. The prevalence of active foot ulceration varies between developed and developing countries depending on the definitions of lower limb lesions used, the population studied, and the health care system and settings [14]. In most European countries, the prevalence of diabetic foot ulcers, reported from community based studies, ranges from approximately 1.0% to more than 4.0% [64, 73, 74]. Whereas in developing countries the prevalence is as high as 11.0% in some nations of the African horn [75]. Studies from Arab countries showed a varying prevalence of diabetic foot ulcers ranging between 5.0% in Jordan [76] to 11.9% in Algeria [77].

DFD causes approximately 40-60% of all non-traumatic lower extremity amputations and, in some regions in the USA, the percentage is as high as 70-90% [14, 15]. The age-adjusted annual incidence of diabetes-related lower limb amputations varies markedly between geographical areas and ethnic groups [78], ranging from 2.1 to 13.7 per 1000 persons with diabetes [79].

The annual incidence rate of diabetes-related lower extremity amputations is relatively high in Oman, with 20-36 amputations performed per 10,000 patients with diabetes per year [52]. In 2002, 280 amputations (upper and lower extremities) were performed in MoH affiliated hospitals, of which 51.8% were attributed to diabetes. Of these 145 diabetes-related amputations, 111 (76.5%) were in males and 34 (23.4%) were in females [80]. While the number (128) and proportion (42.5%) of limb amputations attributable to diabetes performed in 2010 were less than in 2002 [30], the number of limb amputations has fluctuated over the nine-year period. These data may represent the true situation or poor documentation of the reasons for amputation may partly explain the variability. Despite this, the number and rates of diabetes-related amputations amongst males have been consistently higher compared with females (Figure 5) [30, 80].
2.2.3 Costs of lower limb ulceration and amputation

Diabetes-related lower limb amputations as well as hospitalisations for DFD consume a substantial amount of health care resources globally [81-84]. Based on several assumptions reported elsewhere [83], the estimated cost of foot ulcerations and amputations in the US was $10.9 billion in 2001 [83, 85]. A UK-based study which used the same methods, gave a corresponding estimate of 5.0% of the total national health service expenditure, which was equivalent to £3 billion [84]. Apart from the direct medical costs of diabetes-related foot complications, DFD is associated with a significant decrease in health-related quality of life, loss of productivity, and individual patients’ and family costs [23, 72].

Figure 5: The number of diabetes and non-diabetes related lower extremity amputations performed in the Ministry of Health institutions in Oman, 2002 – 2010
Note: Figure generated by accumulating figures reported in the Omani Annual Health Reports [30]
2.3 Prevention and management of DFD

As 85.0% of all diabetes-related lower extremity amputation are preceded by foot ulcers [86], prevention and improved management of foot ulcerations is likely to decrease the incidence of lower limb amputations [55, 72]. A large body of literature has reported that the implementation of relatively simple, yet cost-effective, preventive and therapeutic foot care strategies can reduce the rates of lower extremity ulcerations and subsequent amputations by 44.0% to 85.0% [59, 61, 87]. Further, a recent cost-utility analysis using a risk-based Markov model concluded that the implementation of evidence-based guidelines for preventive foot care measures decreases diabetes-related pedal complications and improves survival, and is highly cost-effective [88]. The preventive strategies and therapeutic foot care strategies include: regular inspection and examination of the feet and footwear; identification of the at-risk feet through screening; education of the patient, the carer, and the health professional; and regular treatment of non-ulcerative pathology of the feet, such as callouses, cracked skin, dry skin and nail deformities [14, 23, 87, 88].

Preventive measures should ideally be delivered in a structured and organised multidisciplinary setting which links primary and secondary health care [59, 89, 90]. Other potentially effective clinical interventions include optimised glycaemic control [91, 92], smoking cessation [60], prescription of custom footwear and orthotics [93, 94], prophylactic [95, 96] and revascularisation foot surgeries [97, 98].
2.3.1 Screening and risk stratification

“Superior doctors prevent the disease. Mediocre doctors treat the disease before evident. Inferior doctors treat the full blown disease”. Huang Dee, China, B. C. 2600

Prevention of diabetes-related foot complications begins with the identification of people at risk of developing foot lesions and amputations [23, 59, 64, 99]. Determining a patient’s level of risk is pivotal in guiding the delivery of appropriate and adequate preventive interventions, such as the frequency of foot examination and foot care education, the prescription of therapeutic shoes, and referrals by primary health care physicians to appropriate specialists for patients identified as having high risk feet [71, 100, 101].

2.3.1.1 Screening

Foot screening should be carried out by skilled and competent health care professionals who can completely examine the feet for PVD, PN, foot deformity, and ulceration. A variety of models for the delivery of foot screening are employed throughout the world. Although diabetes nurses conduct foot screening in most general practice diabetes clinics, a health assistant with adequate training and supervision can perform foot care screening [102]. In some parts of the UK, diabetes clinics established in general practices contract with local podiatry services to carry out foot screening [102]. In addition to performing foot care screening, some contracted podiatry services also deliver basic foot care education [102].

In Oman the diabetes guidelines mandate primary care diabetes clinics to perform regular foot examination [50]. In some PHCCs, a practice diabetes nurse who is a member of the local diabetes team performs the annual foot screening tests for patients with diabetes. In other PHCCs, foot screening is performed by nurses trained in podiatric care [51].
2.3.1.2 Risk stratification

Several diabetic foot risk classification schemes and tools have been developed and used [23]. These include the diabetic foot risk classification system of the International Working Group on the Diabetic Foot (IWGDF), the University of Texas Foot Risk Stratification, and the Scottish Intercollegiate Guideline Network Risk Assessment [103]. These foot risk categorisation systems utilise clinical tools, such as patient medical records, physical examination results, and non-invasive clinical measurements including vibration perception threshold testing, 10-gram Semmes-Weinstein monofilament, and ankle-brachial index [71, 100, 101, 104-106].

The IWGDF developed a simple, yet effective, foot risk identification framework, which classifies patients with diabetes into four foot risk groups (from 0 to 3) according to the presence or absence of certain risk factors including PN, PVD, foot deformity, history of foot ulceration, and lower extremity amputation [101]. A prospective case-control study found this classification system to be highly predictive of lower extremity ulceration and amputation [101]. Over a 36-month follow-up period, 18.8% and 55.8% of foot ulcers occurred in patients assigned to the two highest risk groups 2 and 3, respectively, and amputations were only reported in patients from these two high risk groups. The study concluded that the diabetic foot risk classification system of the IWGDF can be utilised as a tool to prevent lower extremity amputation [101]. Although the IWGDF foot stratification scheme is considered to be accurate in predicting lower limb ulcerations and amputations [107], it has not been adopted in Oman’s primary and secondary care facilities.
2.3.2 Structured interventions in diabetic foot care

“The surest way to produce gangrene is to keep patients alive but only half treat them.”

Frederick M. Allen (1879-1964)

To ensure cost-effective and efficient delivery of care, it is important that health care interventions are delivered in an organised and systematic manner [108, 109]. With regard to diabetic foot care, structures need to be in place to treat the long-term sequelae of DFD [87], and acknowledge the fact that DFD is a lifelong condition [110] requiring life-long surveillance [67]. Successful foot care organisation mandates the presence of several levels of care management. The International Consensus on the Diabetic Foot recommends that all countries adopt a model of at least three levels of foot care management (Table 2) [87], which should be well resourced to provide foot care services for patients with diabetes at different levels of risk [87, 111]. To ensure timely and coordinated approach in preventing and managing diabetic foot problems, effective communication has to be present within and between these levels of care [14, 112, 113].

Table 2: Levels of care in the management of DFD

<table>
<thead>
<tr>
<th>Level of foot care</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>First level</td>
<td>General practitioner, podiatrist, and diabetic nurse</td>
</tr>
<tr>
<td>Second level</td>
<td>Diabetologist, surgeon (general and/or vascular and/or orthopaedic), podiatrist, and diabetic nurse</td>
</tr>
<tr>
<td>Third level</td>
<td>Specialised foot centre with multiple disciplines specialised in in diabetic foot care</td>
</tr>
</tbody>
</table>

Note: Table adapted from Bakker et al. 2012 [87]
2.3.2.1  Multidisciplinary approach

There is a growing body of evidence that organised interdisciplinary patient-centred structure of care maintains a good level of quality of life and improves the quality of foot care provided to patients with diabetes [108, 113, 114].

Diabetic foot management

Due to the highly complex aetiopathogenesis of foot lesions and varying outcomes of diabetic foot management [55], it is widely established that patients with high risk feet or established ulcers must be cared for in a coordinated multidisciplinary diabetic foot clinic [14, 115-117]. Such dedicated centres equipped with health providers from multiple disciplines specialised in foot care (podiatrists, orthopaedic, plastic and vascular surgeons, diabetologists, infectious disease specialists and prosthetists) acknowledges the fact that no one professional possesses the required skills, knowledge, and expertise to manage all aspects of the multifaceted foot conditions [111]. Edmonds et al stated that the long-term objective of high risk diabetic foot clinics should be, through a holistic approach to the foot, to prevent the recurrence of lower limb ulcerations that almost always precedes major and minor amputations [118]. The foot clinic also serves as a window of opportunity to deliver effective patient foot education [70].

Studies from the UK [115, 119-121], Sweden [122], Italy [123], Denmark [124], and Netherlands [125], have found that the introduction of a multidisciplinary foot clinic can significantly decrease the overall incidence of major amputations. Furthermore, foot care in a multidisciplinary setting is linked to decreased length of hospital stay [125], faster ulcer healing rates [89, 115, 126], significant reduction in ulcer recurrence rate [127, 128], improved functional and psychological rehabilitation [129, 130], and lowered health care costs [88, 131, 132].

Several studies have reported a varying range of settings within which a multifactorial team approach of foot care management can optimally function [14, 111,
A multidisciplinary foot care clinic can be associated with large medical centres [111, 118] or can be successfully established in a community-based centre [133, 134]. Members of the team vary from setting to another depending on the availability of human and financial resources [87], but ideally should include diabetologists, podiatrists, and nurses, working in close collaboration with orthopaedic and vascular specialists [70, 87, 111, 135].

In Oman, difficult and more complicated diabetic foot cases are referred from PHCCs to foot clinics located in secondary care polyclinics [51]. A multidisciplinary diabetic foot care team functions as part of the secondary care polyclinics where two clinics, a high risk diabetes clinic and a foot care clinic, are sited next to each other. They operate simultaneously two to three days of the week, and in most cases, the health professionals working in the management of DFD include diabetologists, a general practitioner, a podiatrist, wound care nurses and practice nurses. The foot clinic is equipped with more sophisticated diagnostic and treatment services, compared to primary care centres, required for the diagnosis and management of PVD, PN, and lower extremity ulceration. The availability of highly specialised foot care services, such as advanced casting techniques, off-loading devices, negative pressure wound therapy, radiological studies, and non-invasive vascular laboratory is limited. It is important to note that this secondary level of organised diabetic foot care is not accessible in all districts of Oman due to shortages in local resources, staffing and service infrastructures.

2.3.2.2 Educational interventions: Patient, caregiver, and health professional education

Patient and caregiver

Patient and carer education is an integral part of primary and secondary foot care preventive programmes [14, 18, 23, 59, 61, 87, 135-139]. The objectives of educational
interventions is to increase patient awareness of, and adherence to proper recommended foot care practices, including regular foot examination and care, appropriate feet cares and early identification of potential foot lesions followed by appropriate immediate action [14, 59, 87, 130]. It is widely accepted that patient- and family-directed educational programmes, especially for those at the greatest risk, should be simple, relevant, periodic, patient-centred, and preferably using a variety of methods [14, 23, 87, 135, 140]. The content of educational programmes varies between different clinical settings and may also encompass instruction on glycaemic control, insulin administration, diet, physical activity, smoking cessation, daily foot inspection and care, appropriate footwear and regular shoe inspection, and the urgent need for early notification of foot lesions to health care providers [59, 61, 87, 141-144].

Health professional

Health provider education is equally essential to increase the quality of care delivered to individuals at high risk of DFD [87]. The potential significance of periodic health worker education has been highlighted in several studies [112, 143, 145, 146]. Educational strategies targeting professionals should underscore the importance of performing regular comprehensive foot examination, early identification of the patient at-risk of foot complications, and appropriate early referral to a multidisciplinary team [59, 135]. Various educational strategies for health providers of diabetic foot care have been employed worldwide [20, 114, 147, 148], including the development and implementation of international foot care clinical practice guidelines [71, 87, 135, 149].

A growing body of literature has investigated the effects of physician education and found it to be associated with an overall improvement in clinical practice behaviours [20], significantly increased clinician adherence to foot examination guidelines [21, 22], and led to a reduction in lower extremity ulcerations and amputations when combined with other preventive measures [23]. In preventive educational programmes, all members of the diabetes health care delivery team, especially primary health care professionals, should be
targeted [59]. Other administrative staff responsible for coordinating diabetic foot care might be targeted to improve the coordination between primary and secondary care and to increase their understanding of DFD [14, 59].

2.4 Quality of foot care amongst people with diabetes

Quality health care should be “safe, effective, patient-centred, timely, efficient, and equitable” [150]. The effectiveness of recommended evidence-based preventive and treatment practices in general [151-153] and specifically in DFD [154-157] needs to be continuously monitored to determine the current quality of clinical care provided, identify and reduce gaps in the quality of care, and thus achieve the highest possible quality performance in the provision of health care.

One approach to the evaluation of the quality of health care provided in primary care is the employment of quality indicators (QIs) [158]. A QI can be defined as “a measurable element of practice performance for which there is evidence or consensus that it can be used to assess the quality, and hence improve the quality of provided care” [159]. Quality indicators are further categorised into structure, process, and outcome measures [158]. To date, an international consensus on quality markers to evaluate clinical care has not been reached [160].

2.4.1 Evaluation of the quality of diabetic foot care

Most published studies and reports that have attempted to evaluate the quality of clinical diabetic foot care have done so as part of assessing the overall quality of diabetes care [25, 161-164]. These studies used diabetes-related process and outcome QIs [137, 165], such as:

a) regular annual diabetic foot examination [137, 165],
b) daily foot self-care [166],

c) regular patient foot care education [166],

d) length of hospital stay [167],

e) lower extremity amputation rates [157],

f) ulcer healing and recurrence rates [89], and

g) ulcer-free survival [168].

A large and growing body of literature has investigated the quality of diabetes-related foot care in primary and secondary settings [164, 169-172]. Recent evidence from the UK, New Zealand, and Australia suggests that the quality of diabetes-related foot care in general practice is sub-optimal, and processes of care did not attain internationally or locally established standards of practice [173-178]. A New Zealand population-based study which enrolled 4,611 patients with diabetes found that 35.0% of participating patients had a record of foot pulses [177]. Furthermore, as part of evaluating the overall care provided to diabetic patients in the US, a retrospective cohort study [164] assessed clinical foot care through using foot examination as a process QI. It found that about 35.0% and 64.0% of diabetic patients receiving care in primary care and speciality clinics, respectively, had documented foot examination in the past year [164].

2.4.2 Initiatives to improve the quality of foot care

To improve the overall quality of diabetes care including foot care, a number of initiatives have been implemented worldwide. These include financial incentive programmes, clinical practice guidelines, and diabetes registers.
2.4.2.1 **Financial incentives: pay for performance**

In the UK [179], US [180] and Australia [181], financial incentives to directly reward physicians and medical groups' performance according to certain process and outcome QIs have been introduced in primary care practices to stimulate adherence to specified quality targets [179-181]. In 2004, a pay-for-performance UK scheme known as the Quality and Outcomes Framework (QOF), a large-scale system-wide reform, was introduced for all primary health care physicians [179]. In the 2012 revision of the QOF, fifteen key clinical QIs were used for the assessment of the quality of diabetes care in primary care. The two QIs that referred specifically to diabetes-related foot care were the percentage of patients with diabetes with a record of a foot examination and risk classification within the preceding 15 months, and the percentage of patients with diabetes with a record of neuropathy testing in the preceding 15 months [179].

The impact of the QOF on the quality of diabetes care has been reviewed [182]. A systematic review [183] compared results from six published observational studies of the quality of diabetes care in primary care in the UK with the quality of diabetes data from the QOF incentive programme. The study found process measures attained as result of the QOF to be much higher than those reported in previously published studies [183-189].

In spite of this, several studies have concluded that evidence of the clinical effectiveness of incentive schemes for quality improvement in primary care is inconsistent [190-193] and insufficient [194, 195]. The cost-effectiveness of performance incentive schemes in improving the quality of care is uncertain [180]. Furthermore, financial intervention programmes have paid insufficient attention to potential unintended consequences, such attention shift, gaming, harming patient-doctor relationship, and exacerbating disparities [194, 196]. In summary, to date there is inadequate evidence supporting the use of incentive programmes in primary care to improve processes of care and patient outcomes [194, 195].
2.4.2.2  **Clinical practice Guidelines**

In addition to setting up highly specialised multidisciplinary foot clinics, specific Clinical Practice Guidelines (CPGs) on the prevention and management of the diabetic foot have been developed internationally [71, 87, 135, 149] and locally in Oman [52]. Their importance stem from the fact that there is an urgent need to standardise diabetic foot care practice worldwide based on the best available evidence [197]. Although recommended interventions for patients with diabetes with different foot ulceration risk vary between foot care guidelines, all published CPGs recommend health care professionals to conduct at least one comprehensive foot examination yearly (assessment for anatomical abnormalities, skin breaks, nail disorders, loss of protective and vibratory sensation, reduced arterial supply and improper footwear) when caring for the diabetic patient [71, 87, 135, 149].

Several published reports have demonstrated that adherence to internationally and locally formulated diabetic foot care protocols are linked with reduced rates of major complication as well as length of hospital stay [114, 198]. In an 18-month long study from 1995 through 1996 by Crane *et al* [198], a locally produced protocol for a podiatry-established critical pathway approach to diabetic pedal infections in a hospital setting was evaluated against non-pathway patient groups. For patients with diabetes treated using the pathway model, a significant reduction in hospital length of stay and major amputation was observed when compared to usual care pathway patients.

2.4.2.3  **Diabetes registers**

Another effort directed at improving the process of care and patient outcomes in the management of diabetes in primary care is the establishment of diabetes registers [199, 200]. Regional and nation-wide diabetes registers serve as a tool to monitor and evaluate the quality of diabetes care [136, 201]. Through the provision of good quality data, diabetes registers permit regular auditing, assist in the development and implementation of practice
guidelines, and help with the planning of services [136]. The use of a well organised computerised database, alone or combined with other organisational interventions, was found to be effective in enhancing clinical care as assessed by process and outcome measures for diabetes in general and foot care in particular [162, 202, 203]. An example was the establishment of a regional diabetes register in 1998 in the Otago region, New Zealand as part of a diabetes quality of care improvement project [161]. In this project, general practitioners caring for patients with diabetes enrolled in the register received an annual audit report listing patients who had not had various recommended examinations in the preceding 12 months such as foot examination [161]. In a quality of care an observational study [162], patients with diabetes enrolled on the Otago Diabetes Register (ODR) were compared with the patients not enrolled on the ODR. A statistically significantly higher percentage (75.0%) of enrolled patients had received feet examinations within the previous 12 months compared to the non-register population (62.1%) [162]. The Omani National Diabetes Registry only registers patients diagnosed with diabetes and has no active role in improving the quality of diabetes care.
2.5 **Rationale of the study**

The fact that diabetes is one of the most common chronic diseases amongst the Omani population [43], and it is a major and mounting health concern in Oman, supports the rationale for this study. Moreover, the incidence rate of lower extremity amputations related to diabetes is relatively high in Oman. This negatively impacts on patients with diabetes and their families, especially if they are young working aged parents [52].

Relatively few studies have explored the level of proper foot self-care performance amongst people with diabetes worldwide, and no study was identified that investigated diabetic foot care in Oman. This undoubtedly leaves a gap in understanding the extent of DFD in Oman. Thus, an evaluation of the quality of foot care received by diabetic patients is essential in order to better understand the quality of foot care delivered by primary and secondary health care personnel, and to identify factors associated with foot self-care amongst Omani patients with diabetes.
2.6 Study aim and objectives

The aim of this study was to examine, from the patient perspective, the quality of diabetic foot care provided by primary and secondary health care professionals in Muscat, Oman through the assessment of three foot care quality indicators: foot self-care, foot care education and health professional foot care.

The specific objectives were to undertake a survey of patients with diabetes:

- To ascertain the level of foot self-care amongst patients with diabetes.
- To determine the level of foot care education provided by primary and secondary health care professionals to patients with diabetes.
- To determine the level of professional foot care services provided to patients with diabetes.
- To examine the association between foot self-care practices and socio-demographics of participants, diabetes characteristics, DRFD, foot care education and professional foot care.
3.0 METHODS

“Every method of data collection, including the survey, is only approximation to knowledge. Each provides a different glimpse of reality, and all have limitations when used alone. Before undertaking a survey the researcher would do well to ask if this is the most appropriate and fruitful method for the problem at hand. The survey is highly valuable for studying some problems, such as public opinions, and worthless for others.”

This chapter describes the methods used to conduct this study. The design, ethical approval, study setting, inclusion criteria and study sample are described in sections 3.1 - 3.5. Section 3.6 describes the development and content of the questionnaire. Data collection and management, and statistical analysis are described in sections 3.7, 3.8 and 3.9, respectively.

3.1 Study design

This study was a cross-sectional questionnaire-based survey. It was conducted during the period 3rd March 2012 to 15th April 2012 in Muscat, Oman. A newly constructed Diabetic Foot Disease and Foot Care Questionnaire (DFDFC-Q) (Appendix I) was used.

3.2 Ethics approval

Ethical approval for the study was obtained from the Medical Research and Ethics Review Committee, Ministry of Health, Oman (Appendix II). The study was conducted in accordance with the Helsinki Declaration [205].
3.3 Study setting

Overall there were 26 Primary Health Care Centres (PHCCs) and two polyclinics in Muscat Governorate. Figure 6 shows a detailed map of health care facilities in Muscat Governorate at December 2010. Eight PHCCs and one polyclinic located in one district (wilayat), Alseeb, were invited to participate in this study. Alseeb district was selected as it has the highest population density (185,005 in 2008), the largest number of PHCCs, and the highest number of registered patients with diabetes compared with the other districts in Muscat. Patients with diabetes in Alseeb district represented around 29.0% of the total number of registered patients with diabetes in Muscat [30]. The population living in Alseeb is socio-economically heterogeneous, with different socio-economic classes and education levels.

Figure 6: Diagrammatic distribution of the Oman’s MoH health institutions in Muscat Governorate on December 31, 2010
Note: Figure adapted from the Ministry of Health, 2010
3.3.1 Primary Health Care Centres

Diabetes clinics conducted at the PHCCs were run by a multidisciplinary diabetes team that consisted of a senior family physician, a diabetes practice nurse, dietitians, and health educators. Each diabetes clinic used a MoH provided custom-designed, user-friendly electronic medical record software that aided diabetes clinic doctors to assess and manage their patients with diabetes. It also served as a means to collect relevant patient demographic and diabetes care data.

Diabetes clinics were scheduled on selected days of the week (Saturday to Wednesday) during the hours 7:30 am – 2:30 pm. The number of diabetes clinics held each week was dependent on the number of patients with diabetes registered at the health centre. The number of patients with diabetes seen at each clinic ranged from 10-18 patients [51]. While there were special hypertension clinics, patients with both diabetes and essential hypertension were seen in the diabetes clinics. Patients with diabetes were generally seen every 2-3 months with more frequent appointments as clinically necessary depending on the patient's condition [51].

3.3.2 Polyclinics

The polyclinics are considered to be secondary health care facilities. Each polyclinic consists of a high risk diabetes clinic, a specialised foot care clinic as well as other outpatient clinics. Diabetes clinics and foot care clinics at Alseeb Polyclinic were run twice per week by consultant diabetologists and podiatrists. Patients with complications and poorly controlled diabetes were referred to Alseeb Polyclinic by primary health care doctors in Alseeb district and neighbouring districts according to specific criteria for referral outlined in the Policy on Quality Improvement of Diabetes Care [51]. These referred diabetes cases were complicated and required more specialised clinical management and care.
3.4 Patients

The patient eligibility criteria were:

- Omani men and women with diabetes who were registered and attended diabetes clinics at primary and secondary health care facilities in Alseeb district.
- Aged 20 years or above.
- Type 1 or type 2 diabetes.
- Provision of verbal consent.

3.5 Sample size

This study used a convenient sample. It was decided that a minimum convenient sample size of 300 patients would provide sufficient information to describe the quality of foot care in the study area. The sample size was increased to 350 to improve generalizability and to compensate for missing data.
3.6 Questionnaire

3.6.1 The development of the Diabetic Foot Disease and Foot Care Questionnaire (DFDFC-Q)

A review of the literature revealed existing questionnaires that examined DFD and/or the quality of foot care in many countries. Questionnaires that examined aspects of foot care including diabetes-related foot disease, foot self-care, foot care education and professional foot care were accessed and reviewed.

Two suitable questionnaires were identified. These were the Diabetes Foot Care Questionnaire from the Diabetes Care Program of Nova Scotia (DFQ-DCPNS) (Appendix III), and the Questionnaire for Diabetic Foot Disease (Q-DFD), which was developed in Australia by Shan M Bergin et al. [206] (Appendix IV). Permission for using and modifying the DFQ-DCPNS and Q-DFD was obtained from the Diabetes Care Program of Nova Scotia and Shan Bergin, respectively. These questionnaires were modified in order to better suit the Omani culture and the Omani population living with diabetes [50]. Consequently, a questionnaire, based on standard and recognised guidelines, was used [207-209].

The questionnaire consisted of six domains. They were:

- Socio-demographic characteristics
- Diabetes-related foot disease
- Foot self-care
- Footwear
- Foot care education
- Professional foot care
3.6.1.1  *Survey pre-tests*

The questionnaire was pre-tested first in English in Dunedin, New Zealand, then in Arabic in Muscat, Oman. The goals of the pre-tests were 1) to determine the duration to complete the questionnaire, 2) to determine the clarity and comprehension of the survey (the language used and survey content and structure), and 3) to provide the principal investigator with the necessary experience to administer the questionnaire in the main study [210].

3.6.1.2  *English pre-test*

The English version of the questionnaire was pre-tested in New Zealand using a community-based sample. Seven participants were recruited from the local Dunedin community through advertisements distributed in local communities (Dunedin Islamic Centre, Al-Huda Mosque). Participants were required to have type 1 or type 2 diabetes, be aged 20 years or above, and be competent in oral English.

The principal investigator administered the questionnaire at the Al-Huda Mosque. No names were recorded on the draft questionnaires. After completing the survey participants were asked to report back on the language used, the length of the survey and the clarity and comprehension of the content. Also, the principal investigator recorded the time taken to complete each survey interview and recorded any questions that participants found to be unclear or ambiguous (Figure 7).

Following the English version pre-test, appropriate standard definitions of some medical terms were added and laminated photos of foot deformities such as bunions, clawed toe, corns and callouses were developed as a supplement to the questionnaire (Appendix V).
3.6.1.3 **Expert review of the DFDFC-Q**

After the first pre-test, the questionnaire was forwarded to nine reviewers in Oman including family physicians who have a long-standing expertise in the fields of diabetes, diabetic foot assessment and management, as well as experts in epidemiology, health policy and public health. The reviewers were asked to provide feedback on the content and the construct of the draft questionnaire.

All reviewers approved the appropriateness and acceptability of the questionnaire. There were some minor suggestions and recommendations pertaining to the order and content of some survey domains. The questionnaire was modified accordingly.

3.6.1.4 **Translation into Arabic**

As the first official language of Omanis is Arabic, the English version of the questionnaire was translated into Arabic. Translation was carried out by two independent medically-trained Arabic native speakers. The two translations were compared, and there were no major discrepancies between the two. This version of the questionnaire was reviewed for language, clarity, and structure by a third independent expert in Arabic language. No further modifications were made.

3.6.1.5 **Arabic pre-test**

The Arabic draft of the questionnaire was pre-tested in a community-based sample. Four people with diabetes who met the study inclusion criteria were recruited from one of the study PHCCs, when they were attending their routine diabetes clinic follow-up appointment. On a selected day consecutive patients attending the diabetes clinic were invited to participate in the study. Verbal and written consent was obtained from the
patients after explaining the study objectives and guaranteeing their anonymity. A copy of the consent form is provided in appendix VI.

The questionnaire was administered by the principal investigator using the same procedures that were planned for the main study. The same process followed in the first pre-test was also followed in the second pre-test. There were no further changes made to the questionnaire.

As a result, a final Arabic version of the DFDFC-Q was formulated (Figure 7). Copies of the DFDFC-Q English and Arabic versions are provided in appendices I and VII.
Initial electronic literature search conducted to identify basic indicators of foot care and any existing survey tools on diabetes-related foot disease.

Diabetic foot quality indicators were found to be basic professional care, foot self-care and foot care education. Two suitable survey tools identified. These are the DFQ-DCPNS and the Q-DFD. The Omani Diabetes Guideline is identified as an invaluable source for Cultural Modification.

Permission sought and obtained.

Initial survey draft formulated.

English Pre-test
First draft circulated for pre-test on length, comprehension, clarity of survey tool.

Expert Opinion
First draft sent to Omani experts for opinion on construct and content.

Feedback from expert panel and first pre-test used to modify content and structure of survey tool. Final draft of the survey comprised of 6 domains.

English version of survey tool translated into Arabic.

Arabic Pre-test
Arabic draft circulated for pre-test on length, comprehension, clarity of survey tool.

Feedback from Arabic and English pre-tests, expert panel members and research team used to produce final Arabic draft of questionnaire.

**Figure 7:** Methodological steps used for the development and pre-testing of the DFDFC-Q
3.7 Data collection

3.7.1 Interviewers

As well as the principal investigator, research assistants were recruited to assist with administering the survey. Community Support Group (CSG) members were approached and six CSG members agreed to assist with data collection. The six CSG members received individualised and group-based training sessions from the principal investigator. The training session included the aims of the study, the meanings of the questions asked, and how and when to use the provided definitions and laminated photos of foot abnormalities. Interviewers’ ability to administer the questionnaire was assessed by the principal investigator [210]. The six interviewers were the same throughout the study.

3.7.2 Recruitment of participants

All patients with diabetes attending their routine diabetes clinic follow-up appointments at primary and secondary health care centres in Alseeb district were consecutively approached and invited to participate in the study. On the selected day, based on the interviewers’ availability and the day the diabetes clinic was run, every consecutive patient who arrived at the clinic was approached in the waiting area. Patients who met the study inclusion criteria were asked if they were willing to participate in the study by completing the questionnaire while they were waiting to see the doctor. Informed written consent was obtained from each patient prior to completing the questionnaire.

In order to calculate the response rate, notes were taken throughout the recruitment period detailing: the number of people approached, the number of people willing to participate and the number of patients who refused. Every effort was made not to miss a potential participant.

Data collection commenced on the 3rd of March 2012 and was completed on the 15th of April 2012. The total number of Omani patients with diabetes registered at all eight
participating PHCCs was 3,998, and the number of diabetes patients registered at each participating PHCC ranged from 173 to 1,000 (Table 3). The number of patients invited to participate in the study at each PHCC was proportionate to the total number of patients with diabetes registered at that respective health centre (Table 3). A further 40 eligible patients were recruited from Alseeb Polyclinic.

Table 3: The number of registered diabetes patients in health care centres in Alseeb at the first quarter of 2010.

<table>
<thead>
<tr>
<th>Clinic</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary health care</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H/C 1</td>
<td>206</td>
<td>5.2</td>
</tr>
<tr>
<td>H/C 2</td>
<td>695</td>
<td>17.4</td>
</tr>
<tr>
<td>H/C 3</td>
<td>430</td>
<td>10.8</td>
</tr>
<tr>
<td>H/C 4</td>
<td>438</td>
<td>11.0</td>
</tr>
<tr>
<td>H/C 5</td>
<td>563</td>
<td>14.1</td>
</tr>
<tr>
<td>H/C 6</td>
<td>493</td>
<td>12.3</td>
</tr>
<tr>
<td>H/C 7</td>
<td>173</td>
<td>4.3</td>
</tr>
<tr>
<td>H/C 8</td>
<td>1000</td>
<td>25.0</td>
</tr>
<tr>
<td>Total</td>
<td>3998</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Abbreviation: H/C - health care centre

3.7.3 Completion of the questionnaires

The number of questionnaires completed was different each day. On average each interview took 15-20 minutes to complete. When respondents were not able to complete the questionnaire during the time they were waiting for their appointment, the interview was continued after they had seen their doctor. All interviews were conducted in Arabic.

To maintain privacy and confidentiality, each patient who agreed to participate in the study was assigned a reference number, which was his/her unique Health Care Institution Number (HCIN). No-one except the primary investigator and the biostatistician had access to raw data. The respondent’s diabetes clinic doctor(s), nurses and health officers were not given access to data.
3.8 Data management

After data collection was completed, questionnaires were translated back into English by the primary investigator. The data were entered into a Microsoft Excel Spreadsheet (Microsoft Excel 2010 program) that was prepared earlier. The data were checked for data entry errors, and then rechecked against the hard copies for any other data entry errors. All identified data entry errors were corrected. After tabulation of the data, the spreadsheets were entered into STATA Statistical Software, version 12.0 (2012).

3.9 Statistical analysis

For the descriptive statistics, numbers and proportions were calculated for categorical variables, and means and the standard deviation (SD) were calculated for continuous variables such as age and diabetes duration. Where participants were unsure or refused to respond to particular questions, these responses were not included in the analysis.

3.9.1 Foot self-care score

For foot self-care, study participants were asked 12 questions to identify the frequency of positive or negative foot self-care practices. In this set of questions, eight items (a-g, i) were positive foot care practices, and the remaining four items (h, j, k, and l) were negative foot care practices. Responses for each of the foot self-care questions were scored as follows – never (0), rarely (1), once a month (2), once a week (3), daily (4). For the four items with negative foot care practices, the scores were reversed.

For each participant, the scores for the 12 items were summed, and this provided an overall foot-self-care score, with a maximum score of 48 (4 points for each of the 12 items).
The foot self-care score was divided into quartiles: scores of 37-48 were categorized as good, 25-36 average, 13-24 poor, and ≤12 very poor.

### 3.9.2 Professional foot care education score and provision of professional foot care score.

The provision of foot care education by a health care professional was assessed. The questionnaire enquired about fourteen different aspects of foot care education. ‘No’ responses were scored as 0 and ‘yes’ responses as 1.

The provision of professional foot care during the past year was assessed by 9 items, and a final score was derived in the same way, with ‘no’ responses scored as 0, ‘once’ scored as 1, and ‘more than once’ scored as 2.

### 3.9.3 Predictors of foot care score

A one-way Analysis of Variance (ANOVA) was used to compare differences between subgroups of independent categorical variables. The following categorical variables were tested as potential independent predictors of the foot care score: age group, sex, level of education, marital status, employment status, monthly household income, type of diabetes, duration of diabetes, diabetes treatment, smoking status, and self-reported DRFD. Post-hoc analyses (Scheffé’s Post hoc Test) were then conducted to test for differences between the groups to determine if the overall ANOVA was statistically significant.

Product-moment correlation was used to examine the association between foot self-care score and of foot care education, and professional foot care.

Associations between foot self-care score and several potential variables were examined for statistical significance using simple linear regression modeling on all
available non-missing data. Variables were included in the final model if $P < 0.10$ for the one-way ANOVA. The higher $P$ value of $<0.10$ was considered to increase the chance of including variables that are vital in influencing both the selected cluster of factors and the effects of the statistically significant factors. Because the primary sampling unit was a clinic, the sandwich estimator was used to obtain standard errors in the regression model. For interpretation of the results, two-sided $P < 0.05$ was deemed to be statistically significant. Confidence intervals were calculated at the 95% level of confidence.
4.0 RESULTS

This chapter presents the study results in the following order: 1) participation; 2) characteristics of participants; 3) diabetes-related foot disease; 4) foot self-care; 5) foot care education; 6) professional foot care; and 7) predictors of foot self-care.

4.1 Participation

A total of 353 patients with diabetes were invited to participate in this study. One patient declined to participate due to work commitments. 352 patients completed the questionnaire, but two were excluded as substantial parts of the questionnaires were incomplete for unknown reasons. The total number of questionnaires included in the analysis was 350, giving an overall response rate of 99.2% (Table 4). A total of 310 participants were recruited from the diabetes clinics at the eight selected PHCCs and another 40 participants were recruited from the Polyclinic.

Table 4: The response rate for each participating health clinic.

<table>
<thead>
<tr>
<th>Clinic</th>
<th>Invited</th>
<th>Declined</th>
<th>Incomplete Questionnaire</th>
<th>Total included</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary health care</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H/C 1</td>
<td>56</td>
<td>0</td>
<td>2</td>
<td>54 (96.4)</td>
</tr>
<tr>
<td>H/C 2</td>
<td>17</td>
<td>0</td>
<td>0</td>
<td>17 (100)</td>
</tr>
<tr>
<td>H/C 3</td>
<td>44</td>
<td>1</td>
<td>0</td>
<td>43 (97.7)</td>
</tr>
<tr>
<td>H/C 4</td>
<td>37</td>
<td>0</td>
<td>0</td>
<td>37 (100)</td>
</tr>
<tr>
<td>H/C 5</td>
<td>76</td>
<td>0</td>
<td>0</td>
<td>76 (100)</td>
</tr>
<tr>
<td>H/C 6</td>
<td>34</td>
<td>0</td>
<td>0</td>
<td>34 (100)</td>
</tr>
<tr>
<td>H/C 7</td>
<td>14</td>
<td>0</td>
<td>0</td>
<td>14 (100)</td>
</tr>
<tr>
<td>H/C 8</td>
<td>35</td>
<td>0</td>
<td>0</td>
<td>35 (100)</td>
</tr>
<tr>
<td>Polyclinic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>APC</td>
<td>40</td>
<td>0</td>
<td>0</td>
<td>40 (100)</td>
</tr>
<tr>
<td>Total</td>
<td>353</td>
<td>1</td>
<td>2</td>
<td>350 (99.2)</td>
</tr>
</tbody>
</table>

Abbreviations: H/C - health care centre, APC - Alseeb polyclinic
4.1.1 Characteristics of participants

Table 5 shows the socio-demographic characteristics of the study population. Of the 350 participants, 62.3% were female and more than half (56.5%) were aged 40-59 years. The mean age of participants (n = 306) was 53.8 years (SD ± 11.8). Of note, is that some participants did not know their actual birth date. The majority (80.6%) were married, the level of unemployment was high (57.4%), and more than half of the patients were illiterate (52.9%).

Table 6 shows the clinical diabetes-related characteristics of the study population. About three-quarters (71.4%) indicated that they were not sure of the type of diabetes they had. The overall mean duration of diabetes was 7.9 years (SD ± 7.4). Duration of diabetes was longer for those patients attending the polyclinic (12.0 ± 8.7 years) compared with those attending the PHCCs (7.2 ± 6.9 years). Many of those attending the PHCCs were unsure when their diabetes was diagnosed. Seventy percent managed their diabetes with oral hypoglycaemic agents, 16.0% with insulin only and just over 7.0% were managed with diet only.
Table 5: The socio-demographic characteristics of the participants who attended the primary health care centres or the polyclinic. Data are percentages.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>PHCCs (N=310)</th>
<th>PC (N=40)</th>
<th>Total (N=350)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>36.1</td>
<td>50.0</td>
<td>37.7</td>
</tr>
<tr>
<td>Female</td>
<td>63.9</td>
<td>50.0</td>
<td>62.3</td>
</tr>
<tr>
<td><strong>Age groups (years)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤30</td>
<td>0.6</td>
<td>2.6</td>
<td>0.9</td>
</tr>
<tr>
<td>31-39</td>
<td>8.7</td>
<td>21.1</td>
<td>10.1</td>
</tr>
<tr>
<td>40-49</td>
<td>24.6</td>
<td>21.1</td>
<td>24.2</td>
</tr>
<tr>
<td>50-59</td>
<td>31.1</td>
<td>42.1</td>
<td>32.3</td>
</tr>
<tr>
<td>60-69</td>
<td>23.6</td>
<td>5.3</td>
<td>21.6</td>
</tr>
<tr>
<td>≥70</td>
<td>11.3</td>
<td>7.9</td>
<td>11.0</td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>2.3</td>
<td>2.5</td>
<td>2.3</td>
</tr>
<tr>
<td>Married</td>
<td>80.7</td>
<td>80.0</td>
<td>80.6</td>
</tr>
<tr>
<td>Widowed</td>
<td>14.5</td>
<td>12.5</td>
<td>14.3</td>
</tr>
<tr>
<td>Divorced</td>
<td>2.6</td>
<td>5.0</td>
<td>2.9</td>
</tr>
<tr>
<td><strong>Employment status</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>21.8</td>
<td>35.0</td>
<td>21.7</td>
</tr>
<tr>
<td>Not employed</td>
<td>64.8</td>
<td>42.5</td>
<td>57.4</td>
</tr>
<tr>
<td>Retired</td>
<td>13.4</td>
<td>22.5</td>
<td>13.4</td>
</tr>
<tr>
<td><strong>Level of education</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiterate</td>
<td>53.9</td>
<td>45.0</td>
<td>52.9</td>
</tr>
<tr>
<td>Grade 1-6</td>
<td>10.7</td>
<td>15.0</td>
<td>11.1</td>
</tr>
<tr>
<td>Grade 7-9</td>
<td>18.1</td>
<td>7.5</td>
<td>16.9</td>
</tr>
<tr>
<td>Grade 10-12/Completed grade 12</td>
<td>11.6</td>
<td>27.5</td>
<td>13.4</td>
</tr>
<tr>
<td>Tertiary education</td>
<td>5.8</td>
<td>5.0</td>
<td>5.7</td>
</tr>
<tr>
<td><strong>Monthly household income</strong> (O.M.R)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;300</td>
<td>49.8</td>
<td>15.6</td>
<td>46.0</td>
</tr>
<tr>
<td>300-1000</td>
<td>46.7</td>
<td>81.3</td>
<td>50.5</td>
</tr>
<tr>
<td>&gt;1000</td>
<td>3.5</td>
<td>3.1</td>
<td>3.4</td>
</tr>
<tr>
<td><strong>Smoking status</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>4.0</td>
<td>12.5</td>
<td>5.0</td>
</tr>
<tr>
<td>Ex-smoker</td>
<td>6.0</td>
<td>5.0</td>
<td>5.9</td>
</tr>
<tr>
<td>Never</td>
<td>90.0</td>
<td>82.5</td>
<td>89.1</td>
</tr>
</tbody>
</table>

*PHHCs, n = 309; PC, n = 38, †PHHCs, n = 284, ‡PHHCs, n = 259; PC, n = 32. 1OR=NZ$3.05, 2013), ‡PHHCs, n = 300

Abbreviations: PHCCs - primary health care centre, PC - polyclinic; SD - standard deviation, O.M.R. - Omani Rial
Table 6: The clinical diabetes-related characteristics of the study population attending the primary health care centres or polyclinic. Data are percentages unless otherwise stated.

<table>
<thead>
<tr>
<th>Diabetes descriptors</th>
<th>PHCCs (N=310)</th>
<th>PC (N=40)</th>
<th>Total (N=350)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of diabetes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type 1</td>
<td>7.8</td>
<td>45.0</td>
<td>12.1</td>
</tr>
<tr>
<td>Type 2</td>
<td>12.7</td>
<td>37.5</td>
<td>15.6</td>
</tr>
<tr>
<td>Do not know</td>
<td>79.4</td>
<td>17.5</td>
<td>72.3</td>
</tr>
<tr>
<td><strong>Diabetes treatment</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diet alone</td>
<td>7.7</td>
<td>2.5</td>
<td>7.1</td>
</tr>
<tr>
<td>Oral agents only</td>
<td>74.2</td>
<td>37.5</td>
<td>70.0</td>
</tr>
<tr>
<td>Insulin</td>
<td>12.6</td>
<td>42.5</td>
<td>16.0</td>
</tr>
<tr>
<td>Oral agents + insulin</td>
<td>5.5</td>
<td>17.5</td>
<td>6.9</td>
</tr>
<tr>
<td><strong>Diabetes duration</strong>, mean ± SD, years</td>
<td>7.2 ± 6.9</td>
<td>12.0 ± 8.7</td>
<td>7.9 ± 7.4</td>
</tr>
</tbody>
</table>

*aPHHCs, n = 306 responded
*bPHCCs, n= 235 responded; PC, n= 39 responded.

Abbreviations: SD - standard deviation

4.2 Self-reported foot problems

The types of foot symptoms reported by participants are described in table 7. More than half (55.1%) reported having at least one or more sensory peripheral neuropathy (SPN) symptoms, and almost half (49.1%) reported experiencing one or more symptoms of peripheral vascular disease (PVD) in the last month. The most frequently self-reported SPN symptom was a burning sensation in the foot (38.0%), and night foot pain was the most frequently reported PVD symptom (36.2%). More than one-fifth (22.0%) of patients reported having at least one or more signs of foot deformity, with corns and/or calluses being the most common deformity reported. A small percentage of participants (2.0%) had had a lower limb amputation. More than 15.0% of the respondents reported being diagnosed with SPN and 12.3% with PVD (Table 8).
Table 7: The proportion of patients with diabetes reporting symptoms of sensory peripheral neuropathy and peripheral vascular disease in the last month.

<table>
<thead>
<tr>
<th>DRFD signs and symptoms</th>
<th>Replied</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SPN symptoms: in the last month</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Burning sensation in feet</td>
<td>340</td>
<td>38.0</td>
</tr>
<tr>
<td>Tingling in feet</td>
<td>340</td>
<td>28.9</td>
</tr>
<tr>
<td>Numbness in feet</td>
<td>343</td>
<td>19.2</td>
</tr>
<tr>
<td>Pins and needles in feet</td>
<td>341</td>
<td>26.7</td>
</tr>
<tr>
<td>Heaviness or tightness in feet</td>
<td>338</td>
<td>27.2</td>
</tr>
<tr>
<td>One or more of the SNP symptoms</td>
<td>350</td>
<td>55.1</td>
</tr>
<tr>
<td><strong>PVD symptoms: in the last month</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain or cramping while walking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In calves</td>
<td>344</td>
<td>33.7</td>
</tr>
<tr>
<td>In back of thighs</td>
<td>341</td>
<td>29.6</td>
</tr>
<tr>
<td>In buttocks/bottom area</td>
<td>342</td>
<td>28.1</td>
</tr>
<tr>
<td>Pain in foot at night</td>
<td>329</td>
<td>36.2</td>
</tr>
<tr>
<td>One or more of the PVD symptoms</td>
<td>350</td>
<td>49.1</td>
</tr>
<tr>
<td><strong>Foot ulceration (ever)</strong></td>
<td>335</td>
<td>12.5</td>
</tr>
<tr>
<td><strong>FD signs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hammer or clawed toes</td>
<td>341</td>
<td>1.5</td>
</tr>
<tr>
<td>Bunions</td>
<td>343</td>
<td>3.5</td>
</tr>
<tr>
<td>Corns/callouses</td>
<td>340</td>
<td>11.2</td>
</tr>
<tr>
<td>Lumps or bumps</td>
<td>336</td>
<td>10.7</td>
</tr>
<tr>
<td>One or more of the FD signs</td>
<td>350</td>
<td>22.0</td>
</tr>
<tr>
<td><strong>Lower extremity amputation</strong></td>
<td>346</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Abbreviations: DRFD - diabetes-related foot disease, SPN - sensory peripheral neuropathy, PVD - peripheral vascular disease, FD - foot deformity
Table 8: Patient-reported diagnosis of sensory peripheral neuropathy and peripheral vascular disease in the last month.

<table>
<thead>
<tr>
<th>Diabetes-related foot disease</th>
<th>Replied</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>SPN diagnosis</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss of feeling in feet</td>
<td>343</td>
<td>9.3</td>
</tr>
<tr>
<td>Nerve damage in feet</td>
<td>343</td>
<td>11.4</td>
</tr>
<tr>
<td>Neuropathy or peripheral neuropathy</td>
<td>335</td>
<td>7.8</td>
</tr>
<tr>
<td>One or more of the above</td>
<td>350</td>
<td>15.4</td>
</tr>
<tr>
<td><em>PVD diagnosis</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blocked arteries in legs and feet</td>
<td>339</td>
<td>5.0</td>
</tr>
<tr>
<td>Poor blood flow in legs and feet</td>
<td>333</td>
<td>7.8</td>
</tr>
<tr>
<td>Peripheral vascular disease</td>
<td>341</td>
<td>4.7</td>
</tr>
<tr>
<td>One or more of the above</td>
<td>350</td>
<td>12.3</td>
</tr>
</tbody>
</table>

4.3 Foot self-care

4.3.1 Foot self-care performance

Foot self-care behaviours reported by patients are described in table 9. Overall, the level of foot self-care was not optimal. Less than half (45.3%) reported looking or having an assistant look at the bottom of their feet daily. About 17.0% of participants reported that they were unable to reach and examine the bottom of their feet and this was a barrier to proper foot care (data not shown). The reasons for this reported by these patients included joint problems (33.3%), excess weight (41.7%) and vision problems (11.7%).

The individual foot self-care activities performed on a daily basis by a high proportion of patients were washing the feet (97.4%) and checking between the toes (73.5%). Foot self-care behaviours that should be avoided but were frequently reported were wearing shoes without socks daily (62.6%), and using lubricants between toes (58.4%).
Table 9: The proportion of patients who reported doing or having an assistant do the different recommended foot self-care practices and the frequency of these practices.

<table>
<thead>
<tr>
<th>Foot self-care practice</th>
<th>Replied</th>
<th>Frequency of foot self-care practice (%)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>N</td>
<td>R</td>
<td>OM</td>
<td>OW</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>Looked at bottom of feet</td>
<td>344</td>
<td>13.7</td>
<td>16.6</td>
<td>11.9</td>
<td>12.5</td>
<td>45.3</td>
<td></td>
</tr>
<tr>
<td>Washed feet</td>
<td>344</td>
<td>1.2</td>
<td>0.9</td>
<td>0.3</td>
<td>0.3</td>
<td>97.4</td>
<td></td>
</tr>
<tr>
<td>Checked between toes</td>
<td>340</td>
<td>6.5</td>
<td>11.2</td>
<td>3.5</td>
<td>5.3</td>
<td>73.5</td>
<td></td>
</tr>
<tr>
<td>Dried between toes</td>
<td>343</td>
<td>10.5</td>
<td>21.9</td>
<td>1.7</td>
<td>4.1</td>
<td>61.8</td>
<td></td>
</tr>
<tr>
<td>Tested water temperature</td>
<td>337</td>
<td>20.8</td>
<td>17.8</td>
<td>1.2</td>
<td>0.9</td>
<td>59.3</td>
<td></td>
</tr>
<tr>
<td>Checked shoes</td>
<td>342</td>
<td>24.9</td>
<td>20.2</td>
<td>1.8</td>
<td>1.2</td>
<td>52.0</td>
<td></td>
</tr>
<tr>
<td>Did not soak feet</td>
<td>339</td>
<td>38.6</td>
<td>5.0</td>
<td>4.7</td>
<td>21.8</td>
<td>29.8</td>
<td></td>
</tr>
<tr>
<td>Used lubricants on feet</td>
<td>340</td>
<td>10.6</td>
<td>22.4</td>
<td>0.6</td>
<td>4.7</td>
<td>61.8</td>
<td></td>
</tr>
<tr>
<td>Did not use lubricants between toes</td>
<td>344</td>
<td>58.4</td>
<td>4.7</td>
<td>0.6</td>
<td>22.1</td>
<td>14.2</td>
<td></td>
</tr>
<tr>
<td>Did not walk bare foot</td>
<td>345</td>
<td>50.1</td>
<td>1.2</td>
<td>0.0</td>
<td>20.6</td>
<td>28.1</td>
<td></td>
</tr>
<tr>
<td>Did not wear shoes without socks</td>
<td>340</td>
<td>62.6</td>
<td>1.2</td>
<td>0.9</td>
<td>20.6</td>
<td>14.7</td>
<td></td>
</tr>
<tr>
<td>Cut toenails</td>
<td>338</td>
<td>3.0</td>
<td>2.1</td>
<td>26.6</td>
<td>60.7</td>
<td>7.7</td>
<td></td>
</tr>
</tbody>
</table>

*Note: All foot self-care practices, except for toenail cutting, are recommended to be done daily by the Omani diabetes guidelines. Toenail cutting is recommended regularly (no recommended interval).
Abbreviations: N – Never, R – rarely, OM - once a month, OW - once a week, D - daily

4.3.2 Foot self-care scores

The overall mean score for patient foot self-care was 29 (range 13-43, SD ± 5.8). Patient foot self-care scores are described in figure 8. The overall level of foot self-care activities performed amongst study participants was average. More than two-thirds (68.0%) of participants attained a foot self-care score within the average category of 25-36, while only 10.0% scored between 37 and 48 (good category).
Figure 8: The number of patients with each of the possible foot self-care scores (n = 350). The maximum possible score was 48.
4.4 Footwear

Traditional Omani sandals were the most common type of footwear worn among the study population (46.0%) followed by leather shoes (21.0%).

**Table 10:** The type of shoes worn by patients.

<table>
<thead>
<tr>
<th>Type of shoes</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pointed toes</td>
<td>2</td>
<td>0.0</td>
</tr>
<tr>
<td>High heels</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Broad round toes</td>
<td>55</td>
<td>14.0</td>
</tr>
<tr>
<td>Flip/flops/thongs</td>
<td>23</td>
<td>6.0</td>
</tr>
<tr>
<td>Athletics/sneakers/runners</td>
<td>5</td>
<td>1.0</td>
</tr>
<tr>
<td>Sandals</td>
<td>178</td>
<td>46.0</td>
</tr>
<tr>
<td>Leather shoes</td>
<td>81</td>
<td>21.0</td>
</tr>
<tr>
<td>Special/custom shoes</td>
<td>42</td>
<td>11.0</td>
</tr>
<tr>
<td>Shoes with adjustable laces</td>
<td>3</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Note: Participants were asked to indicate all types of footwear that they wore.

About three-quarters (72.0%) of the participants did not wear socks (Table 11). Of the 77 people who reported wearing socks, cotton socks were the most common type (72.7%).

**Table 11:** The choice of sockwear worn by participants.

<table>
<thead>
<tr>
<th>Type of socks</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>256</td>
<td>72.0</td>
</tr>
<tr>
<td>Unsure</td>
<td>17</td>
<td>5.0</td>
</tr>
<tr>
<td>Cotton</td>
<td>56</td>
<td>16.0</td>
</tr>
<tr>
<td>Wool</td>
<td>16</td>
<td>5.0</td>
</tr>
<tr>
<td>Synthetic</td>
<td>1</td>
<td>0.0</td>
</tr>
<tr>
<td>Knee highs</td>
<td>4</td>
<td>1.0</td>
</tr>
<tr>
<td>Elastic free</td>
<td>1</td>
<td>0.0</td>
</tr>
<tr>
<td>Seamless</td>
<td>3</td>
<td>1.0</td>
</tr>
<tr>
<td>Diabetes</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Prescription/compression</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Nylons/pantyhose</td>
<td>0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Note: Participants were asked to indicate all types of sockwear that they wore.
4.5 Foot care education by health care professionals

Table 12 shows that generally, the level of foot self-care education provided by health care professionals reported by participants was overall poor. Less than half reported receiving education on most of the recommended foot care activities. Only 61.7% of patients reported receiving education on keeping their feet clean, slightly over half reported being told to keep the skin of their feet moist (52.4%), and 51.8% reported education on inspecting feet daily. The foot care education items that were reported not to have been taught were “using mirror to see the bottom of feet” and “avoiding using hot water bottles or heating pads on feet”, being reported in 23.4% and 26.2% of participants, respectively.

Table 12: The proportion of patients who reported receiving foot care education about the different items from health professionals.

<table>
<thead>
<tr>
<th>Items of foot care education</th>
<th>N replied</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspecting feet everyday</td>
<td>340</td>
<td>51.8</td>
</tr>
<tr>
<td>Keeping feet clean</td>
<td>345</td>
<td>61.7</td>
</tr>
<tr>
<td>Keeping skin moist</td>
<td>338</td>
<td>52.4</td>
</tr>
<tr>
<td>Always wearing shoes and socks</td>
<td>340</td>
<td>33.5</td>
</tr>
<tr>
<td>Avoiding wearing slippers/sandals</td>
<td>328</td>
<td>26.2</td>
</tr>
<tr>
<td>Using mirror to see bottom of feet</td>
<td>337</td>
<td>23.4</td>
</tr>
<tr>
<td>Avoiding using hot water bottles/heating pads on feet</td>
<td>336</td>
<td>26.2</td>
</tr>
<tr>
<td>Avoiding applying henna/colouring of feet</td>
<td>335</td>
<td>29.0</td>
</tr>
<tr>
<td>Not using solutions/traditional medicines on open wounds</td>
<td>329</td>
<td>29.5</td>
</tr>
<tr>
<td>Avoiding removing calluses</td>
<td>338</td>
<td>27.5</td>
</tr>
<tr>
<td>Trimming toenails</td>
<td>343</td>
<td>36.2</td>
</tr>
<tr>
<td>Avoiding smoking</td>
<td>337</td>
<td>49.6</td>
</tr>
<tr>
<td>Whom to call if you had an ulcer, sore or blister</td>
<td>335</td>
<td>41.2</td>
</tr>
<tr>
<td>When to call your doctor, podiatrist, specialist or other health professional if you had an ulcer, sore or blister</td>
<td>338</td>
<td>44.2</td>
</tr>
</tbody>
</table>

Figure 9 shows the number of patients who were taught about the different aspects of diabetes foot self-care. There were 14 different diabetes foot self-care education items. The overall mean number of items that patients reported they had been taught about was 4.8 (SD ± 3.9). Almost one-fifth (17.5%) of participating patients reported receiving no
information or advice on foot care, and about three-quarters (73.7%) received education on 7 out of the 14 items. A small proportion (7.0%) reported receiving education about 13 foot self-care activities, and no patients reported receiving education about all 14 foot self-care activities.

Figure 9: The number of patients with each of the possible foot care education scores (n = 342). Maximum possible score was 14.
4.6 Professional foot care

Table 13 shows the proportion of patients who reported having the different recommended foot care practices undertaken during the last year. Not all participants (84.8%) reported having their feet examined during the previous 12 months. Around 20.0% reported that they had not had a test for feeling in their feet, and 44.0% had not been educated on how to choose proper footwear. Although four out of the eight items were delivered more than once a year for the majority of participants, only 21.7% had seen a podiatrist in the past year (data not shown).

Table 13: The proportion of patients who reported having the different professional foot care practices undertaken during the last year and the frequency with which they were done.

<table>
<thead>
<tr>
<th>Professional foot care services</th>
<th>Replied N</th>
<th>Annual frequency of foot care (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No (%)</td>
<td>Once (%)</td>
</tr>
<tr>
<td>Examine feet</td>
<td>342</td>
<td>15.2</td>
</tr>
<tr>
<td>Check between toes</td>
<td>335</td>
<td>17.6</td>
</tr>
<tr>
<td>Ask about numbness</td>
<td>334</td>
<td>20.4</td>
</tr>
<tr>
<td>Test feeling in feet</td>
<td>331</td>
<td>20.5</td>
</tr>
<tr>
<td>File callouses</td>
<td>330</td>
<td>57.3</td>
</tr>
<tr>
<td>Cut toenails</td>
<td>335</td>
<td>60.9</td>
</tr>
<tr>
<td>Inspect shoes</td>
<td>336</td>
<td>59.8</td>
</tr>
<tr>
<td>Educate on proper footwear</td>
<td>334</td>
<td>44.0</td>
</tr>
</tbody>
</table>
The provision and frequency of professional foot care during the past year was assessed by 9 items. If all items were reported by patients to have been completed on more than one occasion, a maximum score of 18 was possible. The overall mean score was 9.7 (SD ± 5.9). The number of patients with each professional foot care score are shown in figure 10. Twenty-seven (8.0%) patients reported receiving no professional foot care services in the previous 12 months.

Figure 10: The number of patients with each of the attained professional foot care scores (n = 338). Maximum score was 18.
4.7 Predictors of foot self-care

A one-way ANOVA was used to examine differences in foot self-care scores between subgroups of independent categorical variables (Table 14). There was a statistically significant difference in foot self-care scores between male and female participants. The mean score for males was 29.9, and the mean score for females was 28.5 (P = 0.033). A significant association was also found between age groups and foot self-care score (P = 0.021), with those aged less than 50 years having higher scores than older patients. Furthermore, significant associations were observed for level of formal education (P = 0.003) and type of diabetes treatment (P = 0.002). Those who had received a tertiary education and those whose diabetes was treated with diet only had the highest scores, 32.1 and 31.8, respectively.

Post-hoc tests showed that the difference in scores between those treated with insulin only and those treated with diet only was significantly different (P = 0.008). There were no statistically significant differences between foot self-care scores and gender, age category, and level of education.

Correlational analyses were conducted to assess the relationship between foot self-care scores, and foot care education and professional foot care scores. The results demonstrated positive significant correlations between foot self-care and foot care education (r = 0.14, P = 0.0075) and professional foot care (r = 0.25, P <0.0001).

There were no statistically significant associations between foot self-care scores and marital status, employment status, monthly household income, smoking habits, type of diabetes, diabetes duration, history of DRFD (foot ulceration, foot deformities, lower extremity amputation, and SNP and PVD symptoms) and reported diagnoses of SPN and PVD (Table 14).
Table 14: Relationship between socio-economic, diabetes, and foot characteristics and foot self-care behaviours.

<table>
<thead>
<tr>
<th></th>
<th>Foot Self-Care Score</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>Mean Score</td>
<td>SD(^a)</td>
</tr>
<tr>
<td>Overall</td>
<td></td>
<td>350</td>
<td>29.0</td>
<td>5.8</td>
</tr>
<tr>
<td>Socio-demographics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td>132</td>
<td>29.9</td>
<td>4.9</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td>218</td>
<td>28.5</td>
<td>6.2</td>
</tr>
<tr>
<td>Age groups, Years (n = 347)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤39</td>
<td></td>
<td>38</td>
<td>29.2</td>
<td>4.3</td>
</tr>
<tr>
<td>40-49</td>
<td></td>
<td>84</td>
<td>30.8</td>
<td>4.8</td>
</tr>
<tr>
<td>50-59</td>
<td></td>
<td>112</td>
<td>28.1</td>
<td>6.2</td>
</tr>
<tr>
<td>60-69</td>
<td></td>
<td>75</td>
<td>28.6</td>
<td>6.2</td>
</tr>
<tr>
<td>≥70</td>
<td></td>
<td>38</td>
<td>28.9</td>
<td>6.2</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td></td>
<td>8</td>
<td>28.1</td>
<td>5.2</td>
</tr>
<tr>
<td>Married</td>
<td></td>
<td>282</td>
<td>28.9</td>
<td>5.8</td>
</tr>
<tr>
<td>Widowed</td>
<td></td>
<td>50</td>
<td>29.3</td>
<td>5.8</td>
</tr>
<tr>
<td>Divorced</td>
<td></td>
<td>10</td>
<td>30.9</td>
<td>7.0</td>
</tr>
<tr>
<td>Employment status (n = 324)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td></td>
<td>76</td>
<td>29.9</td>
<td>4.3</td>
</tr>
<tr>
<td>Not employed</td>
<td></td>
<td>201</td>
<td>28.6</td>
<td>6.2</td>
</tr>
<tr>
<td>Retired</td>
<td></td>
<td>47</td>
<td>29.5</td>
<td>5.6</td>
</tr>
<tr>
<td>Level of education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiterate</td>
<td></td>
<td>185</td>
<td>28.2</td>
<td>5.9</td>
</tr>
<tr>
<td>Grade 1-6</td>
<td></td>
<td>39</td>
<td>28.2</td>
<td>6.0</td>
</tr>
<tr>
<td>Grade 7-9</td>
<td></td>
<td>59</td>
<td>30.7</td>
<td>4.8</td>
</tr>
<tr>
<td>Grade 10-12/Completed grade 12</td>
<td></td>
<td>47</td>
<td>29.8</td>
<td>5.6</td>
</tr>
<tr>
<td>Tertiary education</td>
<td></td>
<td>20</td>
<td>32.1</td>
<td>5.5</td>
</tr>
<tr>
<td>Monthly household income (O.M.R) (n = 291)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;300</td>
<td></td>
<td>134</td>
<td>28.7</td>
<td>5.6</td>
</tr>
<tr>
<td>300-1000</td>
<td></td>
<td>147</td>
<td>28.9</td>
<td>5.8</td>
</tr>
<tr>
<td>&gt;1000</td>
<td></td>
<td>10</td>
<td>31.1</td>
<td>4.7</td>
</tr>
<tr>
<td>Smoking status (n = 340)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td></td>
<td>17</td>
<td>30.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Ex-smoker</td>
<td></td>
<td>20</td>
<td>27.3</td>
<td>5.0</td>
</tr>
<tr>
<td>Never</td>
<td></td>
<td>303</td>
<td>29.0</td>
<td>5.9</td>
</tr>
<tr>
<td></td>
<td>Foot Self-Care Score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------------</td>
<td>----------------------</td>
<td>-------</td>
<td>-------</td>
<td>------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>Mean Score</td>
<td>SD&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Type of diabetes (n = 346)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type 1</td>
<td>42</td>
<td>29.2</td>
<td>6.2</td>
<td></td>
</tr>
<tr>
<td>Type 2</td>
<td>54</td>
<td>29.8</td>
<td>5.2</td>
<td></td>
</tr>
<tr>
<td>Do not know</td>
<td>250</td>
<td>28.9</td>
<td>5.9</td>
<td></td>
</tr>
<tr>
<td><strong>Diabetes treatment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diet alone</td>
<td>25</td>
<td>31.8</td>
<td>4.7</td>
<td></td>
</tr>
<tr>
<td>Oral agents only</td>
<td>245</td>
<td>29.1</td>
<td>5.8</td>
<td></td>
</tr>
<tr>
<td>Insulin</td>
<td>56</td>
<td>27.0</td>
<td>5.8</td>
<td></td>
</tr>
<tr>
<td>Oral agents + insulin</td>
<td>24</td>
<td>30.7</td>
<td>5.7</td>
<td></td>
</tr>
<tr>
<td><strong>Diabetes duration (n = 274)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5 years</td>
<td>143</td>
<td>28.6</td>
<td>5.1</td>
<td></td>
</tr>
<tr>
<td>5-10 years</td>
<td>52</td>
<td>29.2</td>
<td>6.2</td>
<td></td>
</tr>
<tr>
<td>&gt;10 years</td>
<td>79</td>
<td>29.5</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td><strong>Foot ulceration (n = 335)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>42</td>
<td>29.9</td>
<td>5.6</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>293</td>
<td>29.0</td>
<td>5.8</td>
<td></td>
</tr>
<tr>
<td><strong>One or more of the foot deformity signs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>77</td>
<td>28.6</td>
<td>6.7</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>273</td>
<td>29.1</td>
<td>5.5</td>
<td></td>
</tr>
<tr>
<td><strong>Lower extremity amputation (n = 346)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>7</td>
<td>27.1</td>
<td>6.3</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>339</td>
<td>29.1</td>
<td>5.8</td>
<td></td>
</tr>
<tr>
<td><strong>One or more symptoms of the SPN</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>193</td>
<td>28.5</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>157</td>
<td>29.7</td>
<td>5.5</td>
<td></td>
</tr>
<tr>
<td><strong>One or more symptoms of the PVD</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>195</td>
<td>29.3</td>
<td>5.9</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>155</td>
<td>28.7</td>
<td>5.7</td>
<td></td>
</tr>
<tr>
<td><strong>SPN told by health professional</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>54</td>
<td>28.7</td>
<td>6.3</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>296</td>
<td>29.1</td>
<td>5.7</td>
<td></td>
</tr>
<tr>
<td><strong>PVD told by health professional</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>43</td>
<td>28.0</td>
<td>6.9</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>307</td>
<td>29.2</td>
<td>5.6</td>
<td></td>
</tr>
</tbody>
</table>

Note: n = 350 unless otherwise noted. *SD - standard deviation, P value of <0.05 is significant (indicated in bold).
The effects of the socio-demographic, diabetes characteristics, self-reported DRFD, professional foot care and foot care education characteristics were examined using a linear regression model. The results of this analysis are presented in table 15. A statistically significant association was found between foot self-care scores and the following factors: level of education, diabetes treatment and professional foot care.

**Table 15:** Simple linear regression of predictors of foot self-care scores

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>RSE</th>
<th>95% CI</th>
<th>t Value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0.0638</td>
<td>0.6478</td>
<td>-1.21, 1.34</td>
<td>0.10</td>
<td>0.922</td>
</tr>
<tr>
<td><strong>Age group</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40-49</td>
<td>1.5141</td>
<td>0.8459</td>
<td>-0.15, 3.18</td>
<td>1.79</td>
<td>0.074</td>
</tr>
<tr>
<td>50-59</td>
<td>0.2310</td>
<td>0.9123</td>
<td>-1.55, 2.03</td>
<td>0.26</td>
<td>0.793</td>
</tr>
<tr>
<td>60-69</td>
<td>0.5003</td>
<td>1.0798</td>
<td>-1.62, 2.62</td>
<td>0.46</td>
<td>0.643</td>
</tr>
<tr>
<td>≥70 6</td>
<td>0.8580</td>
<td>1.2218</td>
<td>-1.55, 3.26</td>
<td>0.70</td>
<td>0.483</td>
</tr>
<tr>
<td><strong>Level of education</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 1-6</td>
<td>0.8111</td>
<td>1.0464</td>
<td>-1.25, 2.87</td>
<td>0.78</td>
<td>0.439</td>
</tr>
<tr>
<td>Grade 7-9</td>
<td>1.6822</td>
<td>0.8021</td>
<td>0.10, 3.26</td>
<td>2.10</td>
<td><strong>0.037</strong></td>
</tr>
<tr>
<td>Grade 10-12/Completed grade 12</td>
<td>1.4592</td>
<td>0.9976</td>
<td>-0.50, 3.42</td>
<td>1.46</td>
<td>0.145</td>
</tr>
<tr>
<td>Tertiary education</td>
<td>3.2488</td>
<td>1.2826</td>
<td>0.73, 5.77</td>
<td>2.53</td>
<td><strong>0.012</strong></td>
</tr>
<tr>
<td><strong>Diabetes treatment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oral agents only</td>
<td>2.3437</td>
<td>1.0608</td>
<td>-4.43, -0.26</td>
<td>2.21</td>
<td><strong>0.028</strong></td>
</tr>
<tr>
<td>Insulin</td>
<td>4.4152</td>
<td>1.2432</td>
<td>-6.86, -1.97</td>
<td>3.55</td>
<td>&lt;<strong>0.001</strong></td>
</tr>
<tr>
<td>Oral agents + insulin</td>
<td>0.4682</td>
<td>1.4568</td>
<td>-3.33, 2.40</td>
<td>0.32</td>
<td>0.748</td>
</tr>
<tr>
<td><strong>Foot care education</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional foot care</td>
<td>0.1293</td>
<td>0.0687</td>
<td>-0.01, 0.26</td>
<td>1.88</td>
<td>0.061</td>
</tr>
</tbody>
</table>

Note: N = 331. Abbreviations: RSE - robust standard error, CI - confidence interval, P value of <0.05 is significant (indicated in bold).
5.0 DISCUSSION

This chapter discusses the findings of the study to reflect ways in which the study could contribute to future research and clinical practice [211, 212]. The discussion is structured as follows: 1) a brief statement of key findings, 2) a consideration of possible explanation of the findings and a comparison with published literature, and 3) strengths and limitations of the study.

This was the first epidemiological study to evaluate the quality of diabetic foot care in Oman. It assessed the levels of foot self-care practices, patient foot care education and professional foot care services delivered. Moreover, it identified important predictors associated with foot self-care behaviours, and contributes new information in the field of DFD, particularly for Oman. The results of this study compliment a recent study in Oman which examined diabetes self-management and education of people with diabetes in Muscat [213].

5.1 Statement of key findings

DRFD was common in this study population. More than half of study participants (55.1%) reported having at least one or more sensory peripheral neuropathy (SPN) symptoms, and almost half (49.1%) reported experiencing one or more symptoms of peripheral vascular disease (PVD) in the last month. Despite the high level of DRFD, foot self-care practice was sub-optimal: more than 22.0% of participants had a foot self-care score of 13-24 (poor), and around two-thirds attained a score of 25-36 (average). Fewer than half of the participants reported receiving education on most foot care activities as recommended in the Omani diabetes guidelines. Education on at least one of 14 recommended foot care activities was reported by 82.0% of participating patients. Thus, almost one-fifth reported not receiving any diabetes foot care education.
Self-reported professional diabetes foot care services were provided at low rates amongst this population; for example, about 20.0% of participants reported never being asked about numbness in their feet and 44.0% had not been educated on how to choose proper footwear. Only 20.0% of participants had seen a podiatrist during the previous year.

A statically significant association was found between foot self-care scores and level of formal education, type of diabetes treatment and professional foot care. Gender, age, marital status, employment, DRFD, diabetes duration, and foot care education had no significant association with foot self-care scores.

5.2 Foot self-care practices

Patient-reported foot self-care practices were not optimal amongst study participants. Most people (97.4%) washed their feet daily but less than two-thirds (61.8%) dried between their toes afterwards, and only half (45.3%) looked at the bottom their feet each day. These findings are consistent with previous published research in this field, which suggests foot self-care practices are performed poorly amongst patients with diabetes in other settings [17, 166, 214, 215]. A national population-based study in Italy found that 33% of patients with diabetes did not perform foot self-examination [214]. Another study [17] conducted in a rural triethnic community in North America enquired about the frequency of five different recommended foot care practices. Among the 688 study participants with diabetes 75.6% washed their feet daily and 64.0% dried between their toes [17].

Aside from knowledge, a significant proportion of individuals with diabetes are unable to care for their feet due to co-morbidities, in particular, joint problems, obesity, decreased vision and major depression [37, 166, 216-218]. Amongst this Omani study population, about 17.0% of patients with diabetes reported that they were not able to reach and examine the bottom of their feet. Reported reasons for this included joint problems (33.3%), excess weight (41.7%), and vision problems (11.7%). This suggests the
need for devoting additional time and professional care for these people and the importance of family assistance.

Other reported proposed barriers to foot self-examination include lack of insurance and other financial barriers to accessing health care services [37], time constraints [217], poverty, poor communication skills [219], and the structure of health care systems [37]. Poor communication skills, time constraints and the structure of the Omani health system are possible reasons for poor foot self-care in this study population [220]. However, it is important to note that this study did not set out to investigate barriers to implementing proper foot care among Omani individuals with diabetes; therefore, further inquiry is warranted.

5.2.1 Footwear

Wearing recommended protective footwear was poor amongst participants in this study. Inappropriate and ill-fitting footwear are established risk factors for DFD [23, 221]. Around half of participants reported traditional sandals to be their regular footwear. These sandals are not appropriate for patients with diabetes as they do not offer the protection from trauma provided by closed footwear. However, these results are not entirely surprising as the weather is hot in Oman, and barefoot walking especially inside the home is standard practice among Omanis. Generally, people find it uncomfortable to wear protective closed shoes and socks [222], and patients with diabetes often continue to wear traditional sandals, which offer little protection from trauma. The 2003 Omani diabetes management manual addressed this problem and provided patients with recommendations regarding appropriate footwear [50].

The findings from this study are consistent with results from a UK study which found that only 22.0% of 50 patients with diabetes attending a diabetes foot clinic wore their prescribed free of charge custom-made footwear regularly [223]. Similar poor compliance with prescribed shoes have been reported in Germany with the result being a
higher foot ulcer relapse rate among those who wore their prescribed shoes for less than 60% of the daytime [224]. For those who wore protective shoes for more than 60% of the daytime the ulcer relapse rate was significantly reduced by more than half compared with those wearing the shoes for shorter times (p = 0.0002) [224].

5.2.2 Religion and sociocultural factors

Sociocultural beliefs and practices are likely to play a major role in the adoption and adherence to appropriate feet self-care behaviours among patients with diabetes in Oman [37, 225]. Religion can influence foot self-care in different ways, in particular feet washing and nail trimming. The majority of patients (97.4%) were washing their feet, but not always drying between the toes after washing on a daily basis (61.8%). Frequent daily washing of the feet can be attributed to Islamic ritual ablution (wudhu). Islam instructs its followers to pray five times a day. The feet have to be washed prior to each prayer. While this practice helps individuals to clean and inspect their feet regularly, the feet are not always dried. Muslims, especially males, are highly encouraged to offer their prayers at mosques, which do not allow them to dry their feet and web spaces after wudhu.

Regular nail trimming is also recommended by Islam. This is the most likely explanation for the observed high percentage of study participants (95.0%) who trimmed their nails at least monthly. However, the trimming of nails needs to be done correctly to avoid injury to the toes [222]. This study did not look at whether toe nails were trimmed correctly or not.

Data from this study suggests that education on culturally influenced foot care practices was low. The influence of Islam as a societal order cannot be denied [37]. Omanis, as mentioned previously, undertake sociocultural practices that are considered to be barriers to effective foot care. The use of traditional medicine including cautery, blood-letting and herbal remedies, and the application of henna on body parts are still common practices in the Arab world. The use of sharp tools can increase the risk of foot injury and
ulcer, herbal remedies for treating foot ulcers can further delay appropriate medical
treatment and henna applied to the feet can make foot inspection a difficult task [222].
Thus, patients’ sociocultural and religious beliefs need to be considered by Omani health
care providers when delivering foot care education [226].

5.3 Diabetic foot care in the primary care setting

5.3.1 Foot care education

Foot self-care practice generally reflects the patients’ level of knowledge on foot care. The
lack of appropriate advice and guidance on foot care can lead to infrequent, inadequate or
no foot self-care practices [217]. The level of diabetic foot care education provided by
health care professionals in this study was reported by patients to be poor; less than half of
the participant patients reported receiving education on most foot care activities as
recommended in the Omani diabetes guidelines. Several studies have explored the
association between foot care education and foot self-care, and concluded that patients’
awareness and practices regarding foot care in diabetes are strongly associated with
provider behaviours and practices [17, 166, 214]. In an Italian study that recruited 3,564
patients with diabetes, participants who had received foot care education and those who
had had their feet examined by their doctor in the previous 12 months were significantly
more likely to conduct regular foot self-examination [214].

Patient foot care education, alone or with other preventive foot care strategies, leads
to short-term improvements in foot care knowledge and practice, and may reduce the risk
of diabetic foot complications [14, 18, 19]. Randomised controlled trials have shown that a
one-hour group education session on foot care resulted in a 70.0% reduction in foot
ulceration and lower limb amputations in diabetic patients with high risk feet [227].

In this Omani study, overall 52.9% of participants were illiterate. More people may
have been health illiterate also. Health literacy “is the degree to which individuals have the
capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions” [228]. Poor health literacy is independently associated with sub-optimal diabetes outcomes [229]. In an Egyptian study, health illiteracy regarding diabetes was shown to be a risk factor for DFD especially foot ulceration in more than 90.0% of cases [230]. In Oman, health literacy regarding diabetes care is poor amongst patients with diabetes [231]. Furthermore, knowledge of diabetes has been found to be significantly associated with the level of formal education [232]. Given these literacy and education level factors, the mode of delivery and the content of foot care education needs to be simple, clearly presented and repetitive, and there is a need to address and target risky sociocultural practices.

In Oman the opportunities for patient education is limited and the level of diabetes knowledge is poor among patients with diabetes [213]. Ideally foot care education, as part of diabetes self-management education for patients with diabetes should be delivered by health educators, nurses or doctors using attractive written materials, preferably in groups rather than individual sessions [213]. The lack of educational facilities to train diabetes specialist nurses or health educators in Oman, is a current problem [213].

5.3.2 Professional foot care: foot screening

This study found that a significant proportion of diabetic patients were not offered adequate foot care services. For example, about 20.0% of participants reported never being asked about numbness in their feet and 44.0% had not been educated on how to choose proper footwear. These results are consistent with findings from other published studies which concluded that generally the level of professional diabetes foot services in primary care is inadequate [163, 164, 169-178, 214]. For example, a population-based Australian study found that only half of participating diabetes patients had had their feet checked in the previous year, and about 59.0% of patients reported conducting foot self-exams in the week prior to the study [163]. Moreover, another study from Italy found that just over half
(51.0%) of patients with diabetes reported that they had had received at least one foot examination in the previous 12 months [214].

A number of initiatives have been introduced to improve the quality of care provided to patients with diabetes. These include financial incentive programmes [195], diabetes registers with annual audit reports [161], diabetes management guidelines and health professional education [50].

Primary care financial incentive programmes [179-181] have shown some success worldwide. These programmes have led to improvements in overall processes of diabetes care and reduced prescribing costs, referrals, and admissions. However, it was found to be generally ineffective in promoting practitioners’ adherence to diabetes foot care guidelines [193]. No incentive schemes have been implemented in Oman.

**Health provider foot care education**

Foot education of general practitioners and nurses is equally essential, and found it to be associated with an overall improvement in practitioner practice [20] and adherence to foot examination guidelines [21, 22], and led to reduction in lower extremity ulcerations and amputations when combined with other preventive measures [23]. Currently, there are no educational programmes to provide ongoing diabetes education to primary health care physicians and practice nurses in Oman [213].

**Adherence to clinical practice guidelines**

Adherence to clinical practice guidelines (CPGs) for foot screening and treatment in people with diabetes is associated with significant reductions in DFD related length of hospital stay and in major amputations [114, 198]. International [71, 87, 135, 149] and Omani [52] diabetes foot CPGs recommend that all patients with diabetes should receive at least one annual foot examination which includes assessment for skin abnormalities, structural
deformities, loss of protective sensation, reduced arterial circulation, and improper foot wear [23]. Health care providers have access to the Omani diabetes management guidelines in all primary health care centres in Oman [50].

International CPGs recommend that foot examination of diabetic patients is followed by a stratification of foot risk [23]. The identification of patients’ foot risk level through screening is essential in orienting the delivery of preventive foot care measures [71, 100, 101]. Several foot risk stratification schemes have been found to be effective in preventing lower limb amputations amongst patients with diabetes and promoting higher level of professional foot care [23]. Although no one system has been unanimously adopted [135], a validated foot ulcer risk stratification scheme has been implemented in Scotland [233, 234]. Despite deemed to be accurate in predicting lower limb ulcerations and amputations [101]; no foot risk stratification scheme has been adopted in Oman’s primary and secondary care facilities.

Moreover, to increase general practitioners’ performance in diabetes foot care, a new model of integrated screening service that links between primary and secondary diabetes care has been recently introduced in the UK [235]. In this model, foot screening is carried out at the same time as digital retinal imaging in a mobile screening programme. This approach to foot screening gives primary care diabetes professionals the chance to focus on other areas of diabetes care such as education, provides screening services demanded by the progressively increasing numbers of patients diagnosed with diabetes [236], and is effective in early detection and referral of at risk feet to specialist diabetes foot clinic [235].

5.4 Diabetic foot care in the secondary care setting: podiatry and the multidisciplinary foot care team

In Oman, podiatrists function as part of secondary care polyclinics, and provide specialised diabetes foot care as part of a multidisciplinary foot care team consisting of diabetologists,
a general practitioner, a podiatrist, wound care nurse and diabetes practice nurses. These multidisciplinary foot care teams are not accessible in all districts due to shortages in staffing and service infrastructures. Where they exist, the multidisciplinary foot care teams are not able to meet demand. For instance, in Muscat Governorate alone, there are only two secondary care centres which provide specialised foot care for a large population of more than 13,000 patients with diabetes registered at PHCCs.

Despite the presence of major risk factors for DFD in this Omani diabetic population, only 21.7% of participants saw a podiatrist during the previous year. The 2003 Omani guidelines do not provide information on how frequent patients with diabetes should see a podiatrist [50]. A UK-based cross-sectional study by Pollock et al found that 24.6% of surveyed patients with diabetes had never visited a podiatrist [217]. Reasons for the low level of podiatric service utilisation could be related to the shortage in foot specialists, the number of patients cared for and the lack of appropriate referrals to foot specialists [225, 237].

The role and value of podiatric specialist care in the primary and secondary prevention of DFD has been reviewed. There is good evidence that regular access to podiatry may decrease the prevalence and size of foot callosities [238], improve foot knowledge and self-care [238, 239], and significantly reduce the risk of foot ulceration recurrence in patients with diabetes [127]. Furthermore, several studies conducted in different countries with varying health care settings have clearly demonstrated successful implementation of an integrated multidisciplinary team approach to foot ulcerations and amputation [115, 120-124, 128, 240]. One large prospective Dutch study reported a significant long-term decrease (75.0%) in the incidence rates of major lower limb amputations coincided with improvements in foot care services including the implementation of a multidisciplinary team approach [124].

Immediate access to a highly specialised foot care team can sometimes be limited. Moreover, existing specialist foot care clinics may not be able to accommodate the rising number of diabetic foot ulcer cases due to shortages in financial and human resources [241]. Consequently, some groups of researchers have called for the establishment of
community-based foot care clinics within primary settings that consist of a diabetologist, a primary care physician, a community podiatrist, a diabetes nurse, and an orthotist if possible [133, 241]. Therefore, swift and effective foot care services can be immediately provided when access to multidisciplinary foot team is restricted or pending. However, shifting specialised foot care to primary care means that primary care professionals need to acquire the necessary skills, knowledge, and system resources to deliver good quality foot care [171].

Due to financial constraints in setting up a multidisciplinary foot care clinic and shortages in podiatrists in some health structures, a foot care preventive and treatment programme fully managed and administered by professional nurses with special interest in DFD has been proposed and implemented [242, 243]. Pinzur et al [243] demonstrated that a nurse-managed diabetic foot care protocol of screening, education, and prompt treatment is cost- and resource-effective in reducing diabetic foot ulcerations rate as well as lowering foot amputation risk. Furthermore, a nurse-administered foot care programme based on the IWGDF risk classification has been recently developed in Japan [244]. The programme was found to be effective in reducing the rate of foot infection with tinea pedis and callous formation especially in patients assigned to risk group 3 (history of foot ulceration) [244].

5.5 **Predictors of foot self-care**

Three factors were independently associated with foot self-care practices in this study. Patients who reported receiving better professional foot care services were more likely to engage in recommended foot care activities. This is consistent with data from the Quality of Care and Outcomes in Type 2 Diabetes project (QuED), which showed that individuals who had their feet examined by a health care professional or had been shown how to care for their feet tended to perform regular foot self-examination [214]. This highlights the prominent role of health care providers in guiding patient foot self-care practices.
Participants who had a higher level of educational attainment demonstrated significantly higher scores for foot self-care activities. This is consistent with findings from some published studies [219, 245, 246]. In these studies, diabetes patients who had attained a low level of formal education were significantly less likely to perform foot self-care examination [219, 245, 246]. This correlation may be related to the fact that patients with a high level of formal education are able to read and understand written educational materials, as well as have access to and use information technology to further increase their understanding of the condition. However, other studies suggest that education level has no influence on foot self-care practices [17, 247].

This is the first study to show a statistically significant correlation between foot self-care and diabetes treatment. Patients treated with insulin were more likely to perform foot care activities, a finding that can be explained by the likelihood that patients who are receiving insulin have worse metabolic control, and thus are more likely to have foot complications [65, 66]. However, in this study combination diabetes treatment consisting of insulin and oral agents was not found to be associated with foot care. This inconsistency may be due to the low number of participants that were being treated with a combination of insulin and oral agents.

The presence of DRFD, including PVD, SPN, foot deformity, foot ulceration and lower limb amputation had no impact on the level of foot self-care in this population. Previous reports have found that patients with diagnosed foot complications were significantly more likely to adhere to recommended foot self-care practices [166, 214]. The inconsistent result found in this Omani study may be explained by the fact that data on DRFD was patient-reported. Participants in this study may have under-reported the signs and symptoms of DRFD, and thus the true presence of foot disease in this population. Checking participants' medical records and examining their feet was not done in this study and is a limitation.

Gender was not found to be an independent predictor of foot self-care scores in this study. These results differ from some published studies where female gender was found to be an independent predictor of good foot self-care [17, 214]. However, these results are consistent with other studies from Oman's neighbouring countries, such as Pakistan and
Iran [245, 246]. A cross-sectional study of 148 patients with type 2 diabetes conducted in Iran found no relationship between gender and foot self-care practice [245]. Another cross-sectional study from Pakistan surveyed 150 patients with type 1 and type 2 diabetes, and also found no association between gender and foot self-care activities [246]. A possible explanation for the finding that female gender was not found to be a predictor of good foot self-care in Oman is the fact that women have similar opportunities to attain higher educational status when compared with their male counterpart in Oman.

No statistically significant association was found between foot care education and foot self-care behaviours, contradicting findings from previous studies [166, 214, 217, 238]. The QuED study concluded that patients with diabetes who had received foot care education were at substantially lower risk of not performing regular foot self-examination [247]. Foot care education has been shown to be effective in preventing DRFD [23]. It has been shown that patients who had received no formal diabetes education had a three-fold increase in lower limb amputation risk compared to those who had received diabetes education [63]. The inconsistent findings from Oman may indicate that, on routine diabetes appointments, health care professionals do not have time to deliver adequate education on foot care and that written material is inappropriate for many patients because more than half of participants were illiterate.
5.6 **Strengths and limitations**

The evaluation of the study contained in this thesis draws on recommended criteria and guidelines for appraising observational cross-sectional studies [211, 248, 249].

A key strength of this study was the high participation rate of both patients (99.2%) and PHCCs (100%). One patient declined to participate due to work commitments and two questionnaires were excluded as substantial parts were incomplete for unknown reasons. Being an interviewer-administered survey allowed for consistent explanations of the questions, permitted the use of visual aids, increased the completeness of the questionnaires, maximised the survey invitation acceptance rate, and permitted the participation of illiterate patients [250-252], given that more than half (52.9%) of study participants were illiterate.

Furthermore, the study was conducted in more than one level of care, both primary and secondary care. This allowed a range of patients with varying level of metabolic control and with or without complications to participate in the survey.

The questionnaire, developed from the Q-DFD and the DFQ, used in this study was piloted in two countries (New Zealand and Oman) in English and Arabic languages, respectively. Furthermore, the survey was reviewed for content and structure by a panel of experts in epidemiology, family medicine, podiatry, and diabetes from Oman. These procedures helped minimise ambiguity of the content, reduced the survey length, and improved the format of the survey [210]. It was noted that translating the questionnaire to Arabic language may have introduced problems with the survey [253]. However, as the questionnaire was not self-administered, clarification of questions was able to be sought from the interviewers who administered the questionnaire.

There were several limitations. Findings from this study cannot necessarily be generalised to other urban areas in Oman or indeed to the whole country including rural areas as it is limited by the use of a convenience sampling method. A convenience sample is not ideal as it involves the selection of the most accessible subject which may, therefore,
introduce selection bias [254]. This study was an exploratory study and used a sample limited to just one urban area of Muscat, the capital city. A random sample from a larger area, both urban and rural would have been ideal, but was beyond the scope of the study. Although the structure of urban-based primary and secondary care is similar throughout Oman, based on the results of this survey, the quality of foot care amongst patients with diabetes might be lower, due to lower education status and low socio-economic predictors, in other areas of the country, particularly the rural areas.

Furthermore, the study sample merely consisted of persons with diabetes who attended primary and secondary health facilities and excluded potential subjects using tertiary care level, private healthcare sector, those with diabetes who did not seek medical attention. Nevertheless, this type of sampling was appropriate for the objectives of this study. Other methods of sampling, such as probability sampling methods, were not used due to logistical reasons, in particular time, cost and the setting of the study. Future studies examining the quality of diabetes foot care in Oman should consider a larger, more representative sample size to allow for better generalizability.

Due to the lack of an established and validated tool for the assessment of diabetic foot care in Oman, a newly constructed survey was developed, piloted, and utilised to collect information on diabetic foot care. This study relied on a structured interview using a 6-domain interviewer-administered questionnaire. However, although being trained and coached on how to approach subjects and administer the survey, interviewer bias, a limitation associated with almost all verbally administered questionnaires, could not be avoided [251, 255].

This study used self-report, and the patient replies were not validated through foot examination and checking of medical records. This may have introduced recall bias, thus leading to under or over-reporting of some things such as details of what their doctor had told them about diabetic foot pathology [251]. Patient self-reports are limited by difficulties in recalling particular life events, such as foot self-care practices, especially when carried out with more complex events, a limitation reported by earlier studies [166].
Another problem that may have introduced bias was missing data (unsure and refusal). Although the duration of diabetes is an established risk factor for diabetic foot disease, this Omani study found no association between foot self-care and diabetes duration. This may be explained by the fact that many of the participating patients attending the PHCCs were unsure when their diabetes was diagnosed.

Other potential socio-demographic and health-related variables, which might have influenced foot self-care in this population, such as anthropometric measures (weight, waist circumference, body mass index), physical activity, glycaemic control (blood glucose, glycated haemoglobin), and other comorbidities were not measured or enquired about for logistical reasons. The inclusion of these measures in future studies which seek to examine other potential predictors of DFD is recommended.
6.0 CONCLUSIONS AND RECOMMENDATIONS

This study was designed to investigate the quality of diabetic foot care in a semi-urban area in the Muscat region. Findings show that, overall, patient adherence to foot self-care recommendations was not optimal, and a substantial proportion of patients with diabetes were not offered adequate foot care education nor regular foot examinations. Factors associated with greater performance of recommended foot self-care behaviours were found to be high level of formal education, insulin only treatment and provision of foot care by a health professional.

Furthermore, regular education about diabetes foot care and management of health care professionals is essential for improving their knowledge and skills in performing regular comprehensive foot examination, and early identification of the patient with high risk feet and appropriate early referral to specialist and podiatrist care.

There is a shortage of podiatrists in Oman, and thus limited podiatry services. Therefore, podiatry services should be confined to the care and management of high risk feet in secondary care clinics. Primary foot care screening programmes do not require a high level of podiatry expertise [101]. Regular annual foot screening can be effectively conducted by less qualified health care professionals using internationally validated diabetic foot screening tools, and the IWGDF foot stratification framework [23, 101].

Foot care education is an integral part of the medical management and self-care of patients with diabetes. In the Omani context, members of the diabetes care team, whether primary care or secondary care based, should allocate time during follow-up sessions to provide clear, easily understood and patient-centred education to increase patient awareness of, and adherence to proper foot care practices. Health care providers and educators should also focus on factors found to be associated with foot self-care, such as
level of formal education and the level of professional foot care services provided. Education should be provided with good communication skills and an understanding of the patients’ education levels, level of literacy, and cultural, social and religious beliefs.

Moreover, there is a need to improve the transfer of knowledge to people living with diabetes regarding diabetic foot self-care knowledge and practices so that they can successfully take on more responsibility for managing their diabetes and foot care. This can only be done through allotting time and facilities for the provision of long-term high quality educational programmes by well-trained and relevant health professionals including doctors, nurses and health educators.

As a piece of descriptive exploratory research, it is hoped that this study helps to lay the foundation for better understanding of the quality of foot care provided to Omani people living with diabetes. Nonetheless, additional work and research are required to enhance Omani patients’ and also health care professionals’ knowledge of the extent, spread and burden of DFD in other urban and rural areas alike. Furthermore, barriers to infrequent or non-performance of appropriate foot self-care practices need to be further explored.

Barriers to adherence to the Omani diabetes foot care guidelines, such as performing regular foot examination and patient education, requires further investigation. A revised version of the Omani diabetes guidelines was launched on 14 October 2012, and these new guidelines for diabetes management are expected to play a major role in the improvement of care and services for diabetes including foot care.

Given the limitations present in this study, the findings remain to be confirmed and expanded by future research. However, the results from this study have confirmed previous literature regarding diabetic foot care practices and served to enhance our understanding of the overall quality foot care provided to Omani persons with diabetes. A discussion of the findings of this study amongst the policy makers and health care planners in the MoH in Oman could lead to suggestions to strengthen and improve the quality of diabetic foot care.
APPENDICES
Appendix I. Diabetic Foot Disease and Foot Care Questionnaire (DFDFC-Q, English Version)

**Diabetic Foot Disease and Foot Care Questionnaire**

Date:  
Health care institution number:  

1. **Patient Characteristics:**  
   (Note that R is a refusal code and should only be circled whenever a participant refuses to answer a question)
   
a. Sex:  
   - Male  
   - Female  

b. Age:  
   - Date of Birth:  
   - Unsure  
   - R

   If you do not want to tell us your age or date of birth can you tell us instead which age group you are in?
   - 20-29  
   - 30-39  
   - 40-49  
   - 50-59  
   - 60-69  
   - 70 or older  
   - Unsure  
   - R

c. Highest level of education:  
   - None  
   - Some primary school (grade 1-6)  
   - Some secondary school (grade 7-9)  
   - Some high school (grade 10-12)  
   - Completed high school  
   - Vocational degree  
   - Undergraduate university  
   - Postgraduate university

d. Current marital status:  
   - Single  
   - Married  
   - Widowed  
   - Divorced

e. Employment status:  

f. Monthly household income:  
   - Omani Rial (OMR)  
   - Less than 300 OMR  
   - 300-1000 OMR  
   - More than 1000 OMR  
   - R

g. Type of diabetes:  
   - Type 1  
   - Type 2  
   - I don’t know  
   - R

h. Duration of diabetes:  

   - Year of diagnosis:  
   - Unsure  
   - R

i. Current diabetes treatment:  
   - Diet alone  
   - Oral agents only  
   - Insulin  
   - Oral agents and insulin

j. Do you smoke or use tobacco? (cigarettes, cigars, pipe, shisha or otherwise):  
   - Yes  
   - No  
   - Former  
   - R

2. **Diabetes Related Foot Disease:**  
   (i) In the last month have you
   - a. had any burning sensation in your feet?  
   - b. felt any tingling in your feet?  
   - c. felt any numbness in your feet?  
   - d. felt any pain and needles in your feet?  
   - e. felt heaviness or tightness in your feet?

   If you answered with “YES” to any of the above go to question ii  
   If you answered with “NO” to all of the above go to question iii

   (ii) What do you do to make the burning/tingling/numbness/pains and needles/tightness go away?
(iii) In the last month have you felt

a. pain or cramping in your calf/ves when you walk?  Yes  No  Unsure  R

b. pain or cramping in the back of your thigh when you walk?  Yes  No  Unsure  R

c. pain or cramping in your buttocks/bottom area when you walk?  Yes  No  Unsure  R

If you answered with “YES” to any of question 3 go to question iv
If you answered with “NO” to all of question 4 go to question v

(iv) When you get the pain in your calf/thigh/buttock how do you make it stop?

(v) a. Do you get pain in your foot or calf when you are in bed at night?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>R</th>
</tr>
</thead>
</table>

b. If YES, how do you make this pain go away?

(vi) Have you been told by your doctor, pediatrician, specialist or other health professional that you have

a. lost some or all of the feeling in your feet because of your diabetes?  Yes  No  Unsure  R

b. damage to your nerves in your feet because of your diabetes?  Yes  No  Unsure  R

c. neuropathy or peripheral neuropathy because of your diabetes?  Yes  No  Unsure  R

d. blocked arteries in your legs and feet because of your diabetes?  Yes  No  Unsure  R

e. bad circulation or poor blood flow in your legs and feet because of your diabetes?  Yes  No  Unsure  R

f. peripheral vascular disease because of your diabetes?  Yes  No  Unsure  R

(vii) a. Have you ever had an ulcer, blister, sore or cut on your feet?

| Yes | No | Unsure | R |

If yes:

b. When was the last time you had an ulcer, blister, sore or cut?
(viii) Do you have/ get

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. hammer or clawed toes?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. bunions?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. corns/ callous on your feet?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f. other lumps or bumps anywhere on your feet that hurt or get rubbed and sore by your shoes?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g. Have you had any part(s) of your feet or legs amputated because of your diabetes?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If yes:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i. Year:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ii. Side:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>iii. Level:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Right</td>
<td>□ Left</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Part of your foot</td>
<td>□ Your leg from the knee down</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Your leg from the hip down</td>
<td>□ Unsure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>□ Unsure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Foot Self-Care:

a. Can you reach and see the bottoms of your feet?

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>If no:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i. What is/are the reason(s):</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Joint problems</td>
<td>Excess weight</td>
<td>Vision problems</td>
<td>Lack of mirror</td>
<td>Others</td>
</tr>
<tr>
<td>If others: Please write down the reason</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

How often have you (or an assistant)

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Rarely</th>
<th>Once a month</th>
<th>Once a week</th>
<th>Daily</th>
<th>Unsure</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. looked at the bottoms of your feet?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. washed your feet?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. checked between your toes?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. dried thoroughly between your toes?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f. tested water temperature with your hands before putting your foot in?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g. checked your shoes for any foreign objects or torn linings before putting them on?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h. soaked your feet?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i. used moisturizing lotions, lubricants or creams on your feet?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>j. used moisturizing lotions, lubricants or creams between your toes?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>k. walked around with your bare foot?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>l. worn shoes without wearing any socks?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>m. cut your own toenails?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4. Footwear:
   a. What kind of shoes do you wear? (Please check all that apply.)
      □ Pointed toes □ High heels □ Broad round toes □ Flip/flops/thongs
      □ Athletics/sneakers/runners □ Sandals □ Shoes made of leather
      □ Special/Custom shoes □ Shoes with adjustable laces, buckles or Velcro
   b. What kind of socks do you wear? (Please check all that apply.)
      □ None □ Unsure
      □ Cotton □ Wool □ Synthetic □ Knee highs □ Elastic-free tops
      □ Seamless socks □ Diabetes socks □ Prescription/compression □ Nylons/panty hose

5. Foot-Care Education:
   Have you been taught about/on
      a. inspecting your feet every day?
         □ Yes □ No □ Unsure □ R
      b. keeping your feet clean?
         □ Yes □ No □ Unsure □ R
      c. keeping your skin moist by using creams, lotions or lubricants?
         □ Yes □ No □ Unsure □ R
      d. always wearing shoes and socks?
         □ Yes □ No □ Unsure □ R
      e. avoiding wearing slippers and sandals?
         □ Yes □ No □ Unsure □ R
      f. using a mirror to see the bottom of your feet?
         □ Yes □ No □ Unsure □ R
      g. Avoiding using hot water bottles or heating pads on your feet?
         □ Yes □ No □ Unsure □ R
      h. avoiding the application of henna/colouring on your feet?
         □ Yes □ No □ Unsure □ R
      i. avoiding the use of medicines, solutions or traditional medicines to open wounds?
         □ Yes □ No □ Unsure □ R
      j. avoiding removing your own callouses?
         □ Yes □ No □ Unsure □ R
      k. trimming your toenails?
         □ Yes □ No □ Unsure □ R
      l. avoiding smoking?
         □ Yes □ No □ Unsure □ R
      m. whom to contact/call if you had an ulcer, sore or blister?
         □ Yes □ No □ Unsure □ R
      n. when to contact/call your doctor, podiatrist, specialist or other health professional if you had an ulcer, sore or blister?
         □ Yes □ No □ Unsure □ R

6. Professional Foot Care:
   (Note that professional refers to your doctor, podiatrist, specialist or other health professional whom you saw for your foot-care)
   a. During the last year, have you seen a podiatrist (foot specialist)?
      □ Yes □ No □ Unsure □ R

      If yes:
         i. Date of last visit:
            □ Date: □ Unsure □ R

      During the last year, did the professional
      b. examine your feet?
         □ No □ Once □ More than once □ Unsure □ R
      c. check between your toes?
         □ No □ Once □ More than once □ Unsure □ R
      d. ask about numbness in your feet?
         □ No □ Once □ More than once □ Unsure □ R
      e. test feeling in your feet?
         □ No □ Once □ More than once □ Unsure □ R
      f. file your callouses?
         □ No □ Once □ More than once □ Unsure □ R
      g. cut your toenails?
         □ No □ Once □ More than once □ Unsure □ R
      h. inspect your shoes?
         □ No □ Once □ More than once □ Unsure □ R
      i. educate you on how to select proper footwear?
         □ No □ Once □ More than once □ Unsure □ R
Appendix II. Letter of Ethical Approval

Sultanate of Oman
Ministry of Health
Directorate General of Planning
Directorate of Research & Studies

Ref.: MH/DGP/R&S/PROPOSAL APPROVED/3/2012

Date: 25.2.2012

To,
Ibrahim Saleh Al-Busaidi - Principal Investigator,
"The Quality of podiatric care amongst Omani diabetic patients at primary health care facilities in Muscat, Oman"

After compliments.

We are pleased to inform you that your research proposal "The Quality of podiatric care amongst Omani diabetic patients at primary health care facilities in Muscat, Oman" has been approved by Research and Ethical Review & Approve Committee, MOH.

Regards,

Dr. Ahmed Al Qasmi
Director General Of Planning,
Chairman, Research and Ethical Review & Approve Committee
MOH, Muscat, Sultanate of Oman.

Cc Day file
Appendix III. Diabetes Foot Care Questionnaire from the Diabetes Care Program of Nova Scotia (DFQ-DCPNS)

**Diabetes Foot Care Questionnaire**

Name: ________________________________

Taking care of your feet is an important part of diabetes care. Please answer the following questions about your feet and how you care for them. Please return the completed form to the Diabetes Centre.

**History of Foot Problems**

- Have you ever had a sore or cut on your foot or leg that took more than two weeks to heal? □ Yes □ No
- Have you ever had a foot ulcer? □ Yes □ No
- Have you ever had an amputation of a toe, foot, or leg? □ Yes □ No
  (If yes, date: ___/___/___).

**Current Foot or Leg Problems**

- Do you have an ulcer, sore, or blister on your feet at this time? □ Yes □ No
- Do you have blood or discharge on your socks? □ Yes □ No
- Do you have any calluses on your feet? □ Yes □ No
- Do you have any numbness, tingling, pins and needles, or itching sensation in your feet? □ Yes □ No
- Do you have any tightness, heaviness, pain, or cramps in your feet or legs? □ Yes □ No

**Foot Care**

- Can you reach and see the bottoms of your feet? □ Yes □ No
- Do you examine your feet? (If yes, how often?) □ Yes □ No
  □ every day □ 2-6 times a week
  □ Once a week or less □ When I have a problem
- Do you wash your feet everyday? □ Yes □ No
- Do you dry well between the toes? □ Yes □ No
- Do you use a moisturizing cream on your feet? □ Yes □ No
- Do you cut your own toenails? (If no, who does this for you?) □ Yes □ No
  □ Family member □ Caregiver □ Foot care nurse □ Podiatrist

(Complete other side)
Foot Wear

What kind of shoes do you wear? (Check all that apply.)

- □ pointed toes  □ broad, round toes  □ high heels
- □ sandals  □ flip flops/thongs  □ athletic/sneakers/runners
- □ shoes made of leather or canvas  □ special/custom shoes
- □ shoes with adjustable laces, buckles or velcro

What kind of socks do you wear? (Check all that apply.)

- □ cotton  □ wool  □ acrylic/synthetic
- □ knee highs  □ elastic-free tops  □ seamless socks
- □ nylons/pantyhose  □ “diabetes” socks  □ prescription/compression

Safety and Prevention

- □ Do you ever soak your feet?  □ Yes  □ No
- □ Do you always test water temperature before putting your foot in?  □ Yes  □ No
- □ Do you use medicated products for warts, corns or calluses?  □ Yes  □ No
- □ Do you put moisturizing creams or lotions between your toes?  □ Yes  □ No
- □ Do you ever walk around in your bare feet?  □ Yes  □ No
- □ Do you ever wear shoes without wearing any socks?  □ Yes  □ No
- □ Do you always inspect your shoes for foreign objects or torn linings?  □ Yes  □ No
- □ Do you use a hot water bottle or heating pad on your feet?  □ Yes  □ No
- □ Do you sit with your legs crossed?  □ Yes  □ No
- □ Do you smoke?  □ Yes  □ No

Foot Care Education

- □ Have you ever attended a class on how to care for your feet?  □ Yes  □ No
- □ Have you ever read any handouts on foot care?  □ Yes  □ No
- □ Have you ever read any handouts on proper footwear?  □ Yes  □ No
- □ Would you like a handout on how to care for your feet?  □ Yes  □ No

Thank you for completing this questionnaire!
Appendix IV. A Questionnaire for Diabetic Foot Disease (Q-DFD)

For this questionnaire please refer to reference [206].

The Q – DFD
A Questionnaire for Diabetic Foot Disease
(to be administered by telephone interview)

CONTACT LOG – TO BE COMPLETED FOR EVERY CALL

No answer: allow 1 hour minimum before re-dialling. Maximum number of re-calls should not exceed 5.
At least 1 call attempt should be made after 5pm. If no contact made, list as “no response”.

Exclusions should be noted on the log under comments and will include anyone who cannot be contacted within 5 recalls, or those that refuse or are unable to participate for any reason.

<table>
<thead>
<tr>
<th>CONTACT NUMBER</th>
<th>DATE RECEIVED</th>
<th>DATE OF CALL</th>
<th>TIME OF CALL</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

COMPLETE THIS SECTION ON COMPLETION OF THE INTERVIEW

<table>
<thead>
<tr>
<th>Question</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Was the interview completed with the intended subject?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did the subject provide verbal consent?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

INTERVIEWER TO INITIAL:
Appendix 1 - The Q-

Introduction
Hello, my name is __________________ and I am calling from _______________________.

Note: If subject unavailable or time of call is not convenient make an appointment to call back at a specified time. If subject has moved or is not available 'long term' (due to illness etc) they are excluded. Note this on front page.

Recently you agreed to complete a phone survey being conducted by _________________________________. We are conducting this survey over the next few days and we would like to know whether you would still like to participate?

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
<th>YES BUT AT ANOTHER TIME</th>
</tr>
</thead>
</table>

If subject answers NO they are excluded and the call should be ended. If the subject nominates ‘yes but at another time’, record preferred time and day for next call and call back at the specified time.

If subject answers YES, continue.

For your information, the ethics committees from ________________________________ have approved the survey. Completing the survey is entirely optional and if you change your mind and wish to stop at any time during the interview you can do so. Your name and contact details will not be made available to anyone not involved with conducting this survey and once you have completed the survey your contact number will be not be stored.

Can I start by asking you for the following information? Note that R is a refusal code and should be circled whenever a subject refuses to answer a question.

1. What is your age and what is your postcode?

<table>
<thead>
<tr>
<th>Age:</th>
<th>Unsure</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postcode:</td>
<td>Unsure</td>
<td>R</td>
</tr>
<tr>
<td>Suburb:</td>
<td>Unsure</td>
<td>R</td>
</tr>
</tbody>
</table>

If subject refuses to divulge their age offer the following alternative:

If you don’t want to tell me your exact age can you tell me instead which age group you are in?

| 25 - 30 | 31 - 40 | 41 - 50 | 51 - 60 | 61 - 70 | >70 | Unsure | R |

2. How many years ago were you told you had diabetes?

| Years: | Unsure | R |
3. Now I want to ask you some questions about your feet.

a) In the last month have you had any burning sensation in your feet?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>R</th>
</tr>
</thead>
</table>

b) In the last month have you felt any tingling in your feet?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>R</th>
</tr>
</thead>
</table>

c) In the last month have you noticed that your feet feel numb?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>R</th>
</tr>
</thead>
</table>

d) In the last month have you felt pins and needles in your feet?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>R</th>
</tr>
</thead>
</table>

e) In the last month have you felt a tightness or tight feeling in your feet?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>R</th>
</tr>
</thead>
</table>

If subject answers YES to any of the above go to question 5.
If subject answers NO to all of the above go to question 6.

4. What do you do to make the burning / tingling / numbness / pins and needles / tightness go away?
5. a) In the last month have you felt pain in your calf when you walk?  
   *If subject unsure of where “calf” is, it is the back of the lower leg between your knee and ankle.*

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>No</td>
<td>Unsure</td>
<td>R</td>
<td></td>
</tr>
</tbody>
</table>

b) In the last month have you felt pain in the back of your thigh when you walk?  
   *If subject unsure of where back of “thigh” is, it is the back of the upper leg between the knee and hip.*

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>No</td>
<td>Unsure</td>
<td>R</td>
<td></td>
</tr>
</tbody>
</table>

c) In the last month have you felt pain in your buttock or bottom area when you walk?

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>No</td>
<td>Unsure</td>
<td>R</td>
<td></td>
</tr>
</tbody>
</table>

*If subject answers YES to any of question 6 go to question 7.*  
*If subject answers NO to all of question 6 go to question 8.*

6. When you get this pain in your calf/thigh/buttock how do you make it stop?
7.  a) Do you get pain in your foot or calf when you are in bed at night?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>R</th>
</tr>
</thead>
</table>

b) If YES, how do you make this pain go away?

8.  a) Have you been told by your Doctor, Podiatrist, Specialist or other health professional (HP) that you have lost some or all of the feeling in your feet because of your diabetes?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>Don't have Dr, Podiatrist, specialist or HP</th>
<th>R</th>
</tr>
</thead>
</table>

*If subject replies, “Don’t have a Doctor, Podiatrist, specialist or other health professional”, to question 9a), circle the same response automatically for questions 9b,c,d,e and f and go to question 10.*

b) Have you been told by your Doctor, podiatrist, specialist or other health professional that you have damage to the nerves in your feet because of your diabetes?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>Don't have Dr, Podiatrist, specialist or HP</th>
<th>R</th>
</tr>
</thead>
</table>

c) Have you been told by your Doctor, podiatrist, specialist or other health professional that you have neuropathy or peripheral neuropathy because of your diabetes?

| Yes | No | Unsure | Don't have Dr, Podiatrist, specialist or HP | R |
d) Have you been told by your Doctor, podiatrist, specialist or other health professional that you have blocked arteries in your legs and feet because of your diabetes?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>Don’t have Dr, Podiatrist, specialist or HP</th>
<th>R</th>
</tr>
</thead>
</table>

e) Have you been told by your Doctor, podiatrist, specialist or other health professional that you have bad circulation or poor blood flow in your legs and feet because of your diabetes?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>Don’t have Dr, Podiatrist, specialist or HP</th>
<th>R</th>
</tr>
</thead>
</table>

f) Have you been told by your doctor, podiatrist, specialist or health professional that you have Peripheral Vascular Disease because of your diabetes?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>Don’t have Dr, Podiatrist, specialist or HP</th>
<th>R</th>
</tr>
</thead>
</table>

Definitions to give subjects if requested:

Peripheral neuropathy OR neuropathy – damage to any of the nerves in the feet that are responsible for helping us feel pain, working our muscles properly and even helping our feet to sweat.

Peripheral Vascular Disease – bad circulation or blood flow down to the feet and legs usually as a result of blocked or narrow arteries, which can be more common in people with diabetes.

9. Have you ever had an operation to help the blood flow down to your feet and legs? This does not include operations for varicose veins.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>R</th>
</tr>
</thead>
</table>

10. a) Have you ever had an ulcer on your foot (not including your ankle bones)?

If the subject does not know what an ulcer is provide the following definition:

An ulcer is a wound or sore that usually takes more than one month to heal. Ulcers or wounds usually require bandages or dressings to be applied by your doctor, a nurse, a podiatrist or other health professional until they heal up.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>R</th>
</tr>
</thead>
</table>
Appendix 1 - The Q-

b) If YES when was the last time you had an ulcer?


11. a) Have you had any part of your foot or leg amputated because of your diabetes?

If subject is not clear on what 'amputated' means, use the following explanation:

An amputation is where you have an operation to cut off or remove part of your foot or some of your leg.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>R</th>
</tr>
</thead>
</table>

If the subject answers YES to question 11 complete questions 12 and 13.
If subject answers NO to question 11, go to question 14.

b) Can you tell me what part of your leg or foot you have had amputated?

<table>
<thead>
<tr>
<th>Part of your foot</th>
<th>Your leg from the knee down</th>
<th>Your leg from the hip down</th>
<th>Unsure</th>
<th>R</th>
</tr>
</thead>
</table>

c) Can you tell me, how long ago you had the amputation?

<table>
<thead>
<tr>
<th>Year</th>
<th>Unsure</th>
<th>R</th>
</tr>
</thead>
</table>

Each condition listed below has a short definition written under it in case subject requires clarification.

12. a) Do you have hammer or clawed toes

Hammer or clawed toes are where your toes are not straight but are curled over towards the ground at either of the small joints.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>R</th>
</tr>
</thead>
</table>

b) Do you have bunions?

Bunions are when the big joint under the big toes bulges out and your big toe is usually pushed towards the 2nd toe or even lies over the top of it.
### Appendix 1 - The Q-

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>R</th>
</tr>
</thead>
</table>

c) Do you have other lumps or bumps anywhere on the feet that hurt or get rubbed red and sore by your shoes?

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>R</th>
</tr>
</thead>
</table>

d) Do you get corns?

*Corns are small areas of hard skin that usually have a centre or ‘core’ in the middle of them. They usually occur on or between the toes and are painful until removed.*

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>R</th>
</tr>
</thead>
</table>

e) Do you get callous on your feet?

*Callous is hard skin that occurs over any areas under pressure. This can be on the tops of your toes but usually occurs underneath the balls of your feet or around your heels. This can be tender or painful but not always.*

| Yes | No | Unsure | R |
Appendix V. Laminated Photos and Standard Definitions of Foot Abnormalities

For the laminated photos please refer to reference [52].
**Definitions:**

**Peripheral neuropathy or Neuropathy:**
Damage to any of the nerves in the feet that are responsible for helping us feel pain, working our muscles properly and even helping our feet to sweat

**Peripheral vascular disease:**
Bad circulation or blood flow down to the feet and legs usually as a result of blocked or narrowed arteries, which can be more common in people with diabetes

**Ulcer:**
A wound or sore that usually takes more than a month to heal. Ulcers usually require bandages or dressings to be applied by your doctor, a nurse, a podiatrist or other health care professional until they heal up

**Amputated:**
Amputation is where you have an operation to cut off or remove part of your foot or some of your leg

**Hammer or clawed toes:**
Where your toes are not straight, but are curled over towards the ground at either of the small joints

**Bunions:**
Where the big joint under the big toes bulges out and your big toe is usually pushed towards the second 2\(^{nd}\) toe or even lies over the top of it

**Corns:**
Small area of hard skin that usually have a centre or core in the middle of them. They usually occur on or in between the toes and are painful until removed

**Callous:**
Hard skin that occurs over any areas under pressure. This can be under the tops of your toes but usually occurs underneath the ball of your feet or around your heels this can be painful or tender but not always.
Appendix VI. Consent Form (English)

**Study name: The Quality of podiatric care amongst Omani diabetic patients in Muscat, Oman.**

You are being invited to take part in this study which mainly aims at assessing the quality of foot care provided to the Omani diabetic persons. Before you decide whether or not to participate, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

The information you will provide is very useful as it will explore the situation of foot care and diabetes-related foot diseases in addition to your knowledge and ability to perform self-care to your feet. The study will also help the health care providers; the community and the policy and decision makers in the Ministry of Health in improving the quality of foot care for persons with diabetes in addition to decrease and control the rate of amputations.

It is very important that you read this document carefully and ask as many questions as you like before deciding to participate.

After reading the above details, we would like to inform you that your participation in this study is voluntary. You may refuse to participate in the study or you may decide to withdraw from the study at any time and for any reason without having any impact on future medical care provided to you.

We would like to assure you that all information, which is collected, about you during the course of the research will be kept strictly confidential. Any information about you and your name will not be exposed to anybody.

After the study is finished all of your personal data will be destroyed.

**Consent to participate**

I have read all the above and had the chance to ask questions and get appropriate answers. I willingly give my consent to participate in this study.

Subject name/hospital number: ..........................................................
Subject signature: ..........................................................
Date: .................................
Name of the medical person obtaining the consent: ............................
Signature of medical person obtaining the consent: .............................
Appendix VII. Diabetic Foot Disease and Foot Care Questionnaire (DFDFC-Q, Arabic Version)
إذا أجبت بـ "نعم" عن أي من الأسئلة أعلاه فيرجى الانتقال إلى الإجابة عن السؤال

إذا أجبت بـ "لا" عن جميع الأسئلة أعلاه فيرجى الانتقال إلى الإجابة عن السؤال

ماذا تفعل للتخلص من هذه الحركة أو الوزن أو القدرة؟

خلال الشهر الأخير هل:

- أحسنت بشكل يظهر في الساق/ الساقين في أثناء المشي؟
- أحسنت بشكل يظهر في مؤخرة الفخذين في أثناء المشي؟
- أحسنت يدها في موخرة يدك في أثناء المشي؟
- أحسنت يديك أو يدها في موخرة يديك في أثناء المشي؟

إذا أجبت بـ "نعم" عن أي من الأسئلة أعلاه فيرجى الانتقال إلى الإجابة عن السؤال

إذا أجبت بـ "لا" عن جميع الأسئلة أعلاه فيرجى الانتقال إلى الإجابة عن السؤال

إذا أحسنت يدها في موخرة يدك أو يديك أو يدها أو يديك، كيف تتخلص من هذه الحركة أو الوزن أو القدرة؟

هل تشعر بآلام في قدمك أو ساقك أثناء التمثيل؟

إذا أجبت بـ "نعم" عن هذا السؤال، كيف تتخلص من الألم؟

هل سبق أن أغرقت الطبي، اختصاصي الأقدام، الأخصائي، أو أي من العاملين الصغيرين:

- أحكم قد قادت لك الإحصاء؟ أو سبب السكري؟
- أن أصاب قدمك قد صدرت بسبب السكري؟
- إذا كنت تزعم أن الإصابة/السبب الوراثي سبب السكري؟
- إذا كنت تزعم أن الإصابة/السبب الوراثي سبب السكري؟
- إذا كنت تزعم أن الإصابة/السبب الوراثي سبب السكري؟

إذا أجبت بـ "نعم" عن السؤال أعلاه:

هل سبق أن كنت في حالة عديمة، نتيجة، نفاثة، دخل أو شح في قدمك؟

إذا أجبت بـ "لا" عن السؤال أعلاه:

هل سبق أن كنت في حالة عديمة، نتيجة، نفاثة، دخل أو شح في قدمك؟
# الحاجة الشخصية والقدم:

<table>
<thead>
<tr>
<th>رقم</th>
<th>السؤال</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>هل لديك رؤية لأفضل قدر؟</td>
</tr>
<tr>
<td>2</td>
<td>نعم</td>
</tr>
<tr>
<td>3</td>
<td>لا</td>
</tr>
</tbody>
</table>

إذا أجبت بـ "لا" على السؤال أعلاه: 

- لماذا؟ 
- ما السبب؟ 
- وراء ذلك؟
- مشكلة في التغذية؟ 
- زيادة الوزن؟ 
- عدم تواجد مراعاة؟
- مشاكل في الإصبع؟

إذا أجبت بـ "سبب آخر"، فيرجى كتابة السبب أعلاه:

<table>
<thead>
<tr>
<th>السبب الأخر:</th>
</tr>
</thead>
</table>

 disposit علق كل أن تمت تك من يهمك المساعدة بما يكي:

<table>
<thead>
<tr>
<th>رقم</th>
<th>السؤال</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>بالنسبة لي قدر؟</td>
</tr>
<tr>
<td>2</td>
<td>نعم</td>
</tr>
<tr>
<td>3</td>
<td>لا</td>
</tr>
</tbody>
</table>

إذا أجبت بـ "لا" على السؤال أعلاه:

- كيف يمكن أن تتحسن قدرك؟
- كيف يمكن أن تتحسن مراعاة؟
- كيف يمكن أن تتحسن تواجد؟
- كيف يمكن أن تتحسن مشكلة؟
- كيف يمكن أن تتحسن زيادةوزن؟
- كيف يمكن أن تتحسن إصبع؟

إذا أجبت بـ "سبب آخر"، فيرجى كتابة السبب أعلاه:

<table>
<thead>
<tr>
<th>السبب الأخر:</th>
</tr>
</thead>
</table>

 disposit علق كل أن تمت تك من يهمك المساعدة بما يكي:
4. نماذج القدم:
أ. ما أنواع الأحذية التي تلبسها؟ (رجاء اختيار كل أنواع الأحذية التي تلبسها)

- أسفل الشوك
- نمط عتيق
- هما أحذية مصنوعة خصيصا
- أحذية مصنوعة خصيصا
- رياضية
- دنيء ذات أرجل أو أزرار أو فتيل
- جوارب مصنوعة من أنابيب
- جوارب مصنوعة من أنابيب
- جوارب مصنوعة من أنابيب

ب. ما أنواع الجوارب التي تلبسها؟ (رجاء اختيار كل أنواع الجوارب التي تلبسها)

- جوارب مصنوعة من أنابيب
- جوارب مصنوعة من أنابيب
- جوارب مصنوعة من أنابيب
- جوارب مصنوعة من أنابيب
- جوارب مصنوعة من أنابيب

5. التعليمية بالقدم:
هل سبق لك تعاطي بالقدر?

نعم لا

- الماحلات على إدارة القدرات؟
- الماحلات على إدارة القدرات؟
- الماحلات على إدارة القدرات؟
- الماحلات على إدارة القدرات؟
- الماحلات على إدارة القدرات؟
- الماحلات على إدارة القدرات؟

6. التعليمية المهنية بالقدم:
(رجاء معرفة أن المهنية المهنية تشير إلى طبيعة، اختصاصي الأقدام، الأحيائي، أو أي طبيب صحي آخر جدًا في مجال الطلبة بكم)

أ. خلال السنة الماضية، هل رأيت اختصاصي الأقدام؟

- نعم
- لا
- غير متأكد

ب. إذا أجبت نعم، وما هو تاريخ الإجراء؟

د. خلال السنة الماضية، هل قام أي كادر صحفي بـ?

- فحص قدم؟
- جريمة كان تضرر قدم؟
- سؤال عن الأقدام (تقدم الإحصائي)؟
- جريمة كان يعاني من الأقدام؟
- جريمة كان يعاني من الأقدام؟
- جريمة كان يعاني من الأقدام؟

- ملاحظة على الأقدام؟
- ملاحظة على الأقدام؟
- ملاحظة على الأقدام؟
- ملاحظة على الأقدام؟
- ملاحظة على الأقدام؟
- ملاحظة على الأقدام؟

- طريقة حيلية إجراء لاسقفة القدم المفصص؟
REFERENCES


181. McDonald, J., Harris, M.F., Cumming, J., Davies, G.P., Burns, P., *The implementation and impact of different funding initiatives on access to multidisciplinary primary


<table>
<thead>
<tr>
<th>No.</th>
<th>Author(s)</th>
<th>Title and Details</th>
</tr>
</thead>
</table>


