FACTORS ASSOCIATED WITH GLYCEMIC STATUS AMONG TYPE 2 DIABETES MELLITUS PATIENTS IN MERJAN DIABETIC CENTRE, IRAQ

ALI KADHIM ABBOOD AL HASNAWI

FPSK(m) 21
FACTORS ASSOCIATED WITH GLYCEMIC STATUS AMONG TYPE 2 DIABETES MELLITUS PATIENTS IN MERJAN DIABETIC CENTRE, IRAQ

By

ALI KADHIM ABBOOD AL HASNAWI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirement for the Degree of Master of Science

July 2015
COPYRIGHT

All material contained within the thesis, including without limitation text, logos, icons, photographs and all other artwork, is copyright material of Universiti Putra Malaysia unless otherwise stated. Use may be made of any material contained within the thesis for non-commercial purposes from the copyright holder. Commercial use of material may only be made with the express, prior, written permission of Universiti Putra Malaysia.

Copyright © Universiti Putra Malaysia
DEDICATION

This thesis is especially dedicated to my family
my beloved mother “Fadila”, brothers, sisters and “my wife Noora Alsaedi and my
lovely son Jaffer Alhasnawi”

For their great assistance and support for this research throughout the course of this
study.
My uncle and aunt “Dr. Ali Alsaedi & Dr. Ibtisam Alzubadi”
For their endless support, encouragement and great inspiration all the way since the
beginning of my research.

May Allah bless and protect them all.
FACTORS ASSOCIATED WITH GLYCEMIC STATUS AMONG TYPE 2 DIABETES MELLITUS PATIENTS IN MERJAN DIABETIC CENTRE, IRAQ

By

ALI KADHIM ABBOOD

July 2015

Chair : Assoc. Prof. Barakatun Nisak Mohd Yusof, PhD
Faculty : Medicine and Health Sciences

Type 2 diabetes mellitus (DM) is now posing the largest disease threat to Iraq’s health care services with the majority of those patients was reported to have a poor glycemic status. Role of nutrition therapy is important; however, their nutritional status is not being fully addressed. Therefore, this cross sectional study aimed to determine nutritional status-related factors and their contribution to glycemic status in a sample of Iraqi patients.

Patients with T2 DM were recruited as a convenience sample from Merjan Diabetic Centre in Iraq, and participated in this study. Nutritional status characteristics namely anthropometric, biochemical, clinical and dietary intake data including calculated dietary Glycemic Index (GI) and Glycemic Load (GL) were collected. Glycemic status was assessed using the HbA1c level. Medical characteristic and other lifestyle behaviours, including smoking status and physical activity level were also obtained. Factors contributed to glycemic status were determined using multiple linear regression analyses.

A total of 170 diabetic patients (91 males, 79 females), aged 20 to 70 years (51.2 ± 10.2 years) were recruited with a response rate of 91%. In this study, mean HbA1c of the patients was 10.4 ± 1.6% with only 0.6% achieved the target treatment goal of HbA1c < 7%. About 45% and 44.2% of the subjects were overweight and obese respectively. Average daily energy intake of the patients was 2032.7 ± 274.6 kcal with the proportion of macronutrients were in line with the professional bodies’ recommendation. There were seven factors namely; patients who were on diet alone (β= 0.25, t = 3.949, p = 0.0001); LDL level (β= -0.331, t = 5.388, p = 0.0001); dietary GL (β= 0.162, t = 2.714, p = 0.007); physical activity level (β= -0.241, t = -3.580, p = 0.0001); BMI (β= 0.214, t = 3.395, p = 0.001); patients who were on Sulfonylurea (β= -0.167, t = -2.615, p = 0.01); total fiber (β = 0.133, t = -2.169, p = 0.032); were found to be the predictors which has been explained about 45% of the variation (R² = 0.45) in glycemic status.

In conclusion, the present study showed the significant contribution of diet alone, LDL level, Dietary GL, Physical activity, BMI, Sulfonylurea and total dietary fibre to glycemic status. Future studies should consider incorporating these components into the model to increase the effectiveness of any intervention to Iraqi type 2 DM.
Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Master Sains.

FAKTOR PENYUMBANG KEPADA STATUS GLISEMIK DALAM KALANGAN PESAKIT DIABETES MELLITUS JENIS 2 DARI HOSPITAL PENGAJARAN TERPILIH DI IRAQ

Oleh

ALI KADHIM ABOOD

Julai 2015

Pengerusi : Prof Madya Barakatun Nisak Mohd Yusof, PhD
Fakulti : Perubatan dan Sains Kesihatan


Seramai 170 pesakit diabetes (91 lelaki, 79 perempuan) berumur 20 hingga 70 tahun (51.2 ± 10.2 tahun) telah direkrut dengan kadar respons penglibatan sebanyak 91%. Dalam kajian ini, min HbA1c pesakit adalah 10.4 ± 1.6% dengan hanya 0.6% yang telah mencapai matlamat sasaran rawatan HbA1c < 7 %. Hampir 45% dan 44.2% pesakit adalah masing-masing gemuk dan obes. Purata pengambilan tenaga setiap hari oleh pesakit adalah 2032.7 ± 274.6 kkal/hari dengan pembahagian makronutrien selari dengan cadangan profesional. Terdapat tujuh faktor iaitu; melalui nasihat diet sahaja (Beta=0.25, t = 3.949, p=0.0001); kolesterol LDL ( Beta = -0.331, t = 5.388, p = 0.0001); GL diet (Beta = 0.162 , t = 2.714, p= 0.007); tahap aktiviti fizikal ( Beta = -0.241 , t = -3.580, p = 0.0001); IJT ( Beta = 0.214 , t= 3.395, p = 0.001); pesakit yang mengambil Sulfonylurea (Beta=-0.167, t = -2.615, p=0.01); jumlah fiber diet (Beta = 0.133, t = -2.169, p = 0.032); didapat merupakan peramal yang telah menjelaskan kira-kira 45 % daripada variasi (R² = 0.45) kepada status glisemik.
Kesimpulannya, kajian ini menunjukkan sumbangan secara signifikan nasihat diet sahaja, aras LDL, diet GL, aktiviti fizikal, BMI, Sulfonilurea, dan jumlah fiber diet kepada status glisemik. Kajian akan datang patut mempertimbangkan mengabungkan komponen ini dalam model bagi meningkatkan tahap keberkesanan sebarang intervensi kepada pesakit Iraq dengan DM jenis 2.
ACKNOWLEDGEMENTS

First of all, I would like to take this opportunity to praise the Almighty ALLAH SWT as the only GOD of the whole universe who gave me chances to live with this beautiful life. This piece of work would not become possible without the contribution from many people and organizations. In this segment, I would like to acknowledge each and every person who has contributed their efforts in this study by whatever means directly or indirectly.

Most importantly, I would like to acknowledge my supervisor, Dr. Barakatun Nisak Mohd Yusof for her kind assistance and advice, beneficial criticism and observations throughout this master project. I also thank Associate Professor Dr. Hazizi Abu Saad, co-supervisor for his support and guidance throughout the completion of this project. The project was made possible with an effort and dedication played by Prof. Dr. Rafi Al Razoqi from Ministry of Health in Iraq who was the co-researcher of this project.

Besides that, I also would like to express my appreciation to my mother, my wife Noora, my son Jaffer and to my sibling for every concern, understanding, supporting and patient.

Thanks also to both statisticians, Dr. Mumtaz and Dr. Zohra, to the support, advice and guidance given. And a big thanks for all my friends and colleagues in Department of Nutrition and Dietetics for their help. Thanks all people in both countries, Iraq and Malaysia for their support particularly the patients and Iraqi Ministry of Health.
I certify that a Thesis Examination Committee has met on 2 July 2015 to conduct the final examination of Ali Kadhim Abbood on his thesis entitled "Factors Associated with Glycemic Status among Type 2 Diabetes Mellitus Patients in Merjan Diabetic Centre, Iraq" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

Members of the Thesis Examination Committee were as follows:

Norhasmah binti Sulaiman, PhD
Senior Lecturer
Faculty of Medicine and Health Science
Universiti Putra Malaysia
(Chairman)

Hejar binti Abd. Rahman, PhD
Associate Professor
Faculty of Medicine and Health Science
Universiti Putra Malaysia
(Internal Examiner)

Hamid Jan bin Jan Mohamed, PhD
Associate Professor
Universiti Sains Malaysia
Malaysia
(External Examiner)

ZULKARNAIN ZAINAL, PhD
Professor and Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 22 September 2015
This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

**Barakatun Nisak Mohd Yusof, PhD**  
Associate Professor  
Faculty of Medicine and Health Sciences  
Universiti Putra Malaysia  
(Chairman)

**Hazizi Abu Saad, PhD**  
Associate Professor  
Faculty of Medicine and Health Sciences  
Universiti Putra Malaysia  
(Member)

_________________________  
**BUJANG KIM HUAT, PhD**  
Professor and Dean  
School of Graduate Studies  
Universiti Putra Malaysia

Date:
Declaration by graduate student

I hereby confirm that:

- this thesis is my original work;
- quotations, illustrations and citations have been duly referenced;
- this thesis has not been submitted previously or concurrently for any other degree at any other institutions;
- intellectual property from the thesis and copyright of thesis are fully-owned by Universiti Putra Malaysia, as according to the Universiti Putra Malaysia (Research) Rules 2012;
- written permission must be obtained from supervisor and the office of Deputy Vice-Chancellor (Research and Innovation) before thesis is published (in the form of written, printed or in electronic form) including books, journals, modules, proceedings, popular writings, seminar papers, manuscripts, posters, reports, lecture notes, learning modules or any other materials as stated in the Universiti Putra Malaysia (Research) Rules 2012;
- there is no plagiarism or data falsification/fabrication in the thesis, and scholarly integrity is upheld as according to the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) and the Universiti Putra Malaysia (Research) Rules 2012. The thesis has undergone plagiarism detection software.

Signature: ____________________ Date: __________________

Name and Matric No.: Ali Kadhim Abbood Al-Hasnawi (GS35186)
Declaration by Members of Supervisory Committee

This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) are adhered to.

Signature:

Name of Chairman of Supervisory Committee:

Signature:

Name of Member of Supervisory Committee:
## TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>i</td>
</tr>
<tr>
<td>ABSTRAK</td>
<td>ii</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>iv</td>
</tr>
<tr>
<td>APPROVAL</td>
<td>v</td>
</tr>
<tr>
<td>DECLARATION</td>
<td>vi</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>xii</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>xiii</td>
</tr>
<tr>
<td>LIST OF ABBREVIATIONS</td>
<td>xv</td>
</tr>
</tbody>
</table>

### CHAPTER 1

**INTRODUCTION**
- 1.1 Study Background
- 1.2 Problem Statement
- 1.3 Significance of the Study
- 1.4 Study Objective
- 1.5 Specific Objectives
- 1.6 Null Hypothesis
- 1.7 Conceptual Framework

### CHAPTER 2

**LITERATURE REVIEW**
- 2.1 Overview of Type 2 Diabetes Mellitus
  - 2.1.1 Pathophysiology of Type 2 Diabetes Mellitus
  - 2.1.2 Global Epidemic of Type 2 Diabetes and Scope of the Problem in Iraq
  - 2.1.3 Glycemic Status Parameters
  - 2.1.4 Glycemic Control Improves Diabetes Related Complications
- 2.2 Glycemic Status of Type 2 Diabetes, from Middle East Perspective
- 2.3 Diabetes Management
- 2.4 Factors Associated with Glycemic Status
  - 2.4.1 Socio-Demographic and Glycemic Status
  - 2.4.2 Medical Characteristic and Glycemic Status
  - 2.4.3 Nutritional and Glycemic Status
- 2.5 Glycemic Index / Glycemic Load Concept
  - 2.5.1 Determination of Glycemic Index Values
  - 2.5.2 Method for Calculating Dietary Glycemic Index Glycemic Load Dietary Assessment
  - 2.5.3 Availability and Assigning of Glycemic Index Values
- 2.6 Dietary Glycemic Index/ Glycemic Load and Glycemic Status
  - 2.6.1 Effect of Low Glycemic Index Diet on Glycemic Control
- 2.7 Physical Activity Level and Glycemic Status
  - 2.7.1 Inactivity and Patterns of Physical Activity
  - 2.7.2 Physical Activity Level and Improving Glycemic Control
3 METHODOLOGY
  3.1 Study Design and Location 28
  3.2 Subject Selection and Sample Size Calculation 29
      3.2.1 Inclusion and Exclusion Criteria 29
      3.2.2 Sampling Procedure 30
      3.2.3 Formula and Sample Size Calculation 30
  3.3 Ethical Approval 30
  3.4 Procedures of the Study 30
  3.5 Data Collection and Instruments 31
      3.5.1 Questionnaire Design 31
      3.5.2 Socio-Demographic Data 32
      3.5.3 Medical Status 32
  3.6 Nutritional Status Assessment 33
      3.6.1 Anthropometric Data 33
      3.6.2 Biochemical and Clinical Assessment 34
      3.6.3 Dietary Intake Data 36
      3.6.4 Calculated Dietary Glycemic Index and Glycemic Load 37
  3.7 Physical Activity 38
  3.8 Quality Control 39
      3.8.1 Validity of the Questionnaires 39
      3.8.2 Reliability of the Questionnaires 40
  3.9 Statistical Analysis 40

4 RESULT
  4.1 Screening, Recruitment and Response Rate 42
  4.2 Socio-Demographic Characteristics 42
  4.3 Medical Background and Treatment Modalities 44
  4.4 Nutritional Status 45
      4.4.1 Anthropometric Data 45
      4.4.2 Biochemical and Clinical Data 46
      4.4.3 Dietary Intake 50
  4.5 Dietary Glycemic Index and Glycemic Load 53
  4.6 Physical Activity Level 54
  4.7 Factors Associated with Glycemic Status 56
      4.7.1 Socio-Demographic Factors and Glycemic Status 56
      4.7.2 Medical Background 57
      4.7.3 Nutritional Status Factors and Glycemic Status Parameter 58
      4.7.4 Dietary Intake and Glycemic Status 60
      4.7.5 Physical Activity Levels and Glycemic Status 60
      4.7.6 Association between Dietary Glycemic Index and Glycemic Load and Glycemic Status Parameter (HbA1c level) 61
  4.8 Contribution of Factors to Glycemic Status Parameter (HbA1c Level) among Iraqi patient with Type 2 DM 61
      4.8.1 The Significance of the Individual Regression Coefficients 62
5 DISCUSSION
5.1 Screening and Recruitment 64
5.2 Socio-demographic Characteristics 64
5.3 Medical Characteristics 65
5.3.1 Medical Background and Treatment Modalities 66
5.4 Nutritional Status 66
5.4.1 Waist Circumference 68
5.4.2 Glycemic Status 68
5.4.3 Cardio-Vascular Disease Risk 69
5.4.4 Dietary Intake 71
5.5 Dietary Glycemic Index and Glycemic Load 73
5.6 Physical Activity Levels 74
5.7 Factors Associated with Glycemic Status 76
5.7.1 Socio-Demographic Factors and Glycemic Status Parameter (HbA1c level) 76
5.7.2 Medical Background and Glycemic Status Parameter (HbA1c level) 77
5.7.3 Nutritional Status Factors and Glycemic Status 77
5.7.4 Lipid Profiles and Glycemic Status 78
5.7.5 Dietary Intake and Glycemic Status 78
5.8 Physical Activity Levels and Glycemic Status 79
5.9 Calculated Dietary Glycemic Index and Glycemic Load and Glycemic Status Parameter (HbA1c level) 79
5.10 Contribution to Glycemic Status 80

6 CONCLUSION 82
6.1 Summary and Conclusion 82
6.2 Strengths and Limitations of the Study 83
6.3 Recommendations 83

REFERENCES 84
APPENDICES 97
BIODATA OF STUDENT 140
LIST OF PUBLICATION 141
LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Diagnostic values for type 2 DM</td>
<td>7</td>
</tr>
<tr>
<td>2.2</td>
<td>Various study documented glycemic status of patients with type 2 DM across Iraq</td>
<td>13</td>
</tr>
<tr>
<td>2.3</td>
<td>Studies of the effect of low-GI diet on the HbA1c level</td>
<td>24</td>
</tr>
<tr>
<td>3.1</td>
<td>Potential confounding variables examined</td>
<td>32</td>
</tr>
<tr>
<td>3.2</td>
<td>Body mass index classification for adults</td>
<td>34</td>
</tr>
<tr>
<td>3.3</td>
<td>Waist circumference classification</td>
<td>34</td>
</tr>
<tr>
<td>3.4</td>
<td>Target and expected normal values for glycemic status, lipid profiles for patients with type 2 DM</td>
<td>35</td>
</tr>
<tr>
<td>3.5</td>
<td>Examples of light, moderate, and vigorous-intensity activities for healthy adults</td>
<td>38</td>
</tr>
<tr>
<td>4.1</td>
<td>Distribution of patients by Socio-demographic characteristic (n=170)</td>
<td>43</td>
</tr>
<tr>
<td>4.2</td>
<td>Distribution of patients by medical characteristics (n = 170)</td>
<td>44</td>
</tr>
<tr>
<td>4.3</td>
<td>Distribution of patients by receiving treatment modalities (n = 170)</td>
<td>44</td>
</tr>
<tr>
<td>4.4</td>
<td>Distribution of patients by BMI and waist circumference (n=170)</td>
<td>45</td>
</tr>
<tr>
<td>4.5</td>
<td>Glycemic status of the patients by sex (n=170)</td>
<td>47</td>
</tr>
<tr>
<td>4.6</td>
<td>Mean values of the lipid profile of patients (n=170)</td>
<td>47</td>
</tr>
<tr>
<td>4.7</td>
<td>Distribution of patients having accessed to diet therapy ( n=170)</td>
<td>50</td>
</tr>
<tr>
<td>4.8</td>
<td>Distribution of patients by Nutritional intake and recommended goal (n=170)</td>
<td>52</td>
</tr>
<tr>
<td>4.9</td>
<td>Distribution of patients by nutritional intake (n=170)</td>
<td>53</td>
</tr>
<tr>
<td>4.10</td>
<td>Distribution of patients by BMR and energy requirement (n=170)</td>
<td>53</td>
</tr>
<tr>
<td>4.11</td>
<td>Distribution of patients by glycemic status (n=170)</td>
<td>54</td>
</tr>
<tr>
<td>4.12</td>
<td>MET-minutes/week of physical activity level by sex (n=170)</td>
<td>56</td>
</tr>
<tr>
<td>4.13</td>
<td>Distribution of patients by sitting behaviors (n=170)</td>
<td>56</td>
</tr>
<tr>
<td>4.14</td>
<td>HbA1c correlations with age</td>
<td>57</td>
</tr>
<tr>
<td>4.15</td>
<td>Comparison of patients’ HbA1c by socio-demographic and life related factors (n=170)</td>
<td>57</td>
</tr>
<tr>
<td>4.16</td>
<td>Correlation of HbA1c with BMI and waist circumference (n=170)</td>
<td>59</td>
</tr>
<tr>
<td>4.17</td>
<td>Correlations of HbA1c with lipid profile and BL.p</td>
<td>59</td>
</tr>
<tr>
<td>4.18</td>
<td>Relationship between physical activity MET-min score and glycemic status</td>
<td>60</td>
</tr>
<tr>
<td>4.19</td>
<td>Pearson correlation coefficients between GI/GL, and HbA1c</td>
<td>61</td>
</tr>
<tr>
<td>4.20</td>
<td>Factors contribute to glycemic status of diabetic patients</td>
<td>63</td>
</tr>
</tbody>
</table>
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Conceptual Framework of factors associated with glycemic status</td>
<td>5</td>
</tr>
<tr>
<td>2.1</td>
<td>Pathogenesis of Type 2 Diabetes</td>
<td>6</td>
</tr>
<tr>
<td>2.2</td>
<td>Total Numbers of People with Diabetes Globally During the Years 1995-2030.</td>
<td>8</td>
</tr>
<tr>
<td>2.3</td>
<td>Diabetes Complications</td>
<td>11</td>
</tr>
<tr>
<td>2.4</td>
<td>Changes in Blood Glucose over Time after Consumption of High and Low GI Foods</td>
<td>20</td>
</tr>
<tr>
<td>2.5</td>
<td>Procedure Involved in Determining GI Values</td>
<td>21</td>
</tr>
<tr>
<td>2.6</td>
<td>Potential Mechanisms Linking High Glycemic load Type 2 DM</td>
<td>23</td>
</tr>
<tr>
<td>3.1</td>
<td>Map of Iraq-Location of Diabetic Centre</td>
<td>28</td>
</tr>
<tr>
<td>3.2</td>
<td>Procedures of the Study</td>
<td>31</td>
</tr>
<tr>
<td>4.1</td>
<td>Screening and Recruitment of Studied Patients</td>
<td>42</td>
</tr>
<tr>
<td>4.2</td>
<td>Distribution of Patients According to Age Categories</td>
<td>43</td>
</tr>
<tr>
<td>4.3</td>
<td>Distribution of Patients by Different category of Body Mass Index (n=170)</td>
<td>45</td>
</tr>
<tr>
<td>4.4</td>
<td>Distribution of Patients by Abnormal Waist C circumference (n=170)</td>
<td>46</td>
</tr>
<tr>
<td>4.5</td>
<td>Distribution of Patients’ HbA1c Across Sex (n=170)</td>
<td>47</td>
</tr>
<tr>
<td>4.6</td>
<td>Distribution of Patients with Abnormal Lipid Profile by Sex (n=170)</td>
<td>48</td>
</tr>
<tr>
<td>4.7</td>
<td>Distribution of Patients with Different Systolic Blood Pressure Level by Sex (n=170)</td>
<td>49</td>
</tr>
<tr>
<td>4.8</td>
<td>Distribution of Patients with Different Diastolic Blood Pressure Level by Sex (n=170)</td>
<td>49</td>
</tr>
<tr>
<td>4.9</td>
<td>Distribution Of Patients With Different Stages of Hypertension By Sex (n=170)</td>
<td>50</td>
</tr>
<tr>
<td>4.10</td>
<td>Main Distribution of Patients by Physical Activity Levels (n=170)</td>
<td>55</td>
</tr>
<tr>
<td>4.11</td>
<td>Distribution Of Patients sex by Physical Activity Levels (n=170)</td>
<td>55</td>
</tr>
<tr>
<td>4.12</td>
<td>Distribution of Mean HbA1c by Drugs (n=170)</td>
<td>58</td>
</tr>
<tr>
<td>5.1</td>
<td>Proportion of Obesity Among Different Population In Middle East.</td>
<td>67</td>
</tr>
<tr>
<td>5.2</td>
<td>Physical Activity Among Eastern Mediterranean Population</td>
<td>75</td>
</tr>
<tr>
<td>APPENDIX</td>
<td>Page</td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>97</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>98</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>118</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>130</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>138</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>139</td>
<td></td>
</tr>
</tbody>
</table>

APPENDIX A
Letter of Ethical Approval

APPENDIX B
Information Sheet

APPENDIX C
Questionnaire (Arabic Language Version)

APPENDIX D
Questionnaire (English Language Version)

APPENDIX E
Iraqi Foods Table

APPENDIX F
Poster Presentation

APPENDIX G
Paper of Publication
LIST OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADA</td>
<td>American Diabetes Association</td>
</tr>
<tr>
<td>BMI</td>
<td>Body Mass Index</td>
</tr>
<tr>
<td>BMR</td>
<td>Basal Metabolic Rate</td>
</tr>
<tr>
<td>CVD</td>
<td>Cardiovascular Diseases</td>
</tr>
<tr>
<td>DBp</td>
<td>Diastolic Blood Pressure</td>
</tr>
<tr>
<td>GI</td>
<td>Glycemic index</td>
</tr>
<tr>
<td>GL</td>
<td>Glycemic load</td>
</tr>
<tr>
<td>HbA1c</td>
<td>Glycated Hemoglobin A1c</td>
</tr>
<tr>
<td>HDL-cholesterol</td>
<td>High-density lipoproteins- cholesterol</td>
</tr>
<tr>
<td>LDL-c</td>
<td>Low-density lipoproteins- cholesterol</td>
</tr>
<tr>
<td>MOH</td>
<td>Ministry of Health</td>
</tr>
<tr>
<td>NDGUAE</td>
<td>National Diabetes Guidelines UAE</td>
</tr>
<tr>
<td>OAD</td>
<td>Oral Anti-Diabetics Agents</td>
</tr>
<tr>
<td>RNI</td>
<td>Recommended Nutrients Intake</td>
</tr>
<tr>
<td>SBp</td>
<td>Systolic Blood Pressure</td>
</tr>
<tr>
<td>SD</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>SPSS</td>
<td>Statistical Package for Social Sciences</td>
</tr>
<tr>
<td>UKPDS</td>
<td>United Kingdom Prospective Diabetes Study</td>
</tr>
<tr>
<td>T2DM</td>
<td>Type 2 Diabetes Mellitus</td>
</tr>
</tbody>
</table>
CHAPTER 1
INTRODUCTION

1.1 Study Background

Type 2 Diabetes Mellitus (DM) is a public health problem, which has a substantial impact on morbidity and mortality. Type 2 DM, which affects about 90% of people with diabetes around the world, has been increasing worldwide, particularly in the Middle East (Badran & Laher, 2011). This trend is anticipated to take in a huge wage increase by 2030 (Farag1 & Gaballa2, 2010). In the Middle East, the prevalence of type 2 DM was 10.5% (Habibzadeh, 2012). Likewise, Iraq has not been spared from this challenging problem in as much as the International Diabetes Federation (2010) reported that the prevalence of type 2 DM in 2010 was 10.2%.

The current prevalence is expected to escalate in the near future in line with a drastic rise in obesity and corpulence among the Iraqi population (Alwan, 2011). This is because there is a close tie between the risk of the development of type 2 DM and the growing prevalence of obesity (Farag1 & Gaballa2, 2010). Approximately 90% of the patients who have developed type 2 DM were reported to be obese (Votey & Peters, 2007). Therefore, obesity in Iraq is a growing concern, and several studies have reported on this issue; the most recent one found that the prevalence of obesity among Iraqi men and women was 49% and 58%, respectively (World Health Organization, 2010).

Type 2 DM is characterized by chronic hyperglycaemia resulting from the body’s ineffective use of insulin due to either defective insulin secretion, defective insulin action, or both (World Health Organization, 2013; Hamdy et al., 2008; Juraschek SP, June 2012). Poor glycemic status indicated by HbA1c > 7% is a major cause of diabetes-related complications including microvascular (diabetic nephropathy, neuropathy and retinopathy) and macrovascular (coronary artery disease, peripheral vascular disease and stroke) diseases (Cordova, 2011). Thus, these complications can considerably jeopardize the health of diabetic patients (Frank Hu, 2011; ADA, 2009; Schulze et al., 2004). It has caused significant physical and psychological morbidity, disability and premature mortality among those affected, and imposes financial burden on the health services.

Therefore, improving hyperglycaemia by optimizing the glycated haemoglobin A1c (HbA1c) may be a possible solution for delaying, or even preventing the onset of diabetic complications. One study have shown that each 1% reduction in mean HbA1c, has been associated with a reduction in risk of 21% for various diabetes-related complications (Jay H. Shubrook Jr, 2010).

Hence, glycosylated hemoglobin (HbA1c) index has become the gold standard for long-term monitoring glycemic control and is a validated measurement tool for assessing diabetes status. Therefore, the goal for glycemic control should be feasible to minimize risk for adverse events and reduce load of complications and cost on patients as well as improve glycemic control leading to a decrease in development and progression of vascular complications. On other hand, several studies suggest that there are many factors associated with poor glycemic control, such as low level of education,
higher BMI, hypercholesterolemia, hypertriglyceridemia, and elevated LDL-c (Al-Ibrahim et al., 2012; Farvid et al., 2014).

Another factors that found to be associated with glycemic status of type 2 diabetics were dietary glycemic index (GI) and dietary glycemic load (GL). GI is defined as a measure of carbohydrate quality, which classifies carbohydrate foods, based on their response to postprandial glycaemia (Wolever, 2006). GL is defined as a measure that combines carbohydrate quality and quantity in portion sizes (Wolever, 2006). An Iranian study has been conducted by Esfahani et al. (2009) demonstrated that low GI diets are effective in maintaining optimal glycemic control.

1.2 Problem Statement

Recently, Iraq has been suffering from constant war and conflict, which has had a consequential effect on the health of the Iraqi people. Accordingly, the health system in Iraq has experienced a decline as a result of the embargo and sanctions placed on the country following the Second Gulf War in 1991 (Al Hilfi et al., 2013).

Likewise, the war in 2003 has exacerbated the situation by destroying the infrastructure (Mansour, 2008). In contrast, many countries of Middle East that surrounding Iraq as Saudi Arabia and Iran were established stability and were able to improve their health systems. While the out-break in communicable disease continues, non-communicable chronic diseases, in particular, type 2 DM, now pose the largest disease threat to Iraq's health care services. Although poor glycemic status among Iraqi diabetics is highly prevalent, their nutritional status is not being fully addressed.

However, despite continuous management, this goal (HbA1c of less than 6.5 %) is not often met. Although the data reported in Iraq for the last 10 years have been insufficient, a few studies documented that the average HbA1c level has been recorded as 8.4%, which is higher than the recommended treatment goal. Indeed, only 24% of the patients achieved this target treatment goal (Mansour, 2008).

Another study was conducted in Jordan to determine the factors associated with glycemic control among 917 Jordanian patients with T2DM. Results showed that diabetes was more likely to be poorly controlled among those with increased duration of diabetes, low level of education, higher BMI, had hypercholesterolemia, had hypertriglyceridemia, and had elevated LDL-c. The results of that study suggested that 65.1% of patients had poor glycemic control defined as HbA1c > 7% (Al-Ibrahim et al., 2012).

While other cross sectional study which has been conducted among 1520 diabetic patients who attending King Khalid University Hospital (KKUH) in Riyadh, Saudi Arabia to evaluate glycemic control of diabetic patients, revealed that the overall glycemic control as evaluated by HbA1c was acceptable only in about 40% of the patients. However, many factors may account for this issue, and one of them was poor patient compliance with the treatment modalities. In addition to that were lifestyle modifications (Al-Rowais, 2014).

Most of the studies, which have been conducted in Merjan Hospital, focusing on many others medical related factors such as treatment modality, diabetes complications, diabetes duration and so forth (Al-Razzouqi et al, 2009). None of them have been
focusing on nutritional status, particularly dietary intake and calculated dietary GI/GL. This is important because the traditional diet of the Iraqi people is largely based on polished white rice and refined wheat, which has high GI and GL values (Al-Razzouqi et al, 2009).

Nevertheless, the information on dietary intake featured by a glycemic status among patients who have type 2 DM is inconsistent. The lack of data relevant to the dietary intake, nutritional status and their correlation with dietary GI/GL among Iraqi patients with type 2 DM shows the need for further research. Therefore, the current study is undertaken to address the problem and fill the gap.

1.3 Significance of the Study

Firstly, despite poor glycemic status among Iraqi diabetics is highly prevalent; their nutritional status is not being fully addressed. This study and its findings are conducted to fill the gap in the body of knowledge in the related area.

Secondly, the present study is set to provide an understanding about the contributing factors to glycemic status among Iraqi diabetic patients. The data collected can act as a baseline data which are collected to identify the issues that were contributed to glycemic status of Iraqi diabetic patients. The data can be used as references by doctors, diabetologists, nutritionists and other health care professionals in providing the best services and to identify the appropriate intervention of the targeted group in an effort to improve the overall diabetes outcome of the Iraqi diabetics. It can also be used by Iraqi Ministry of Health in developing an appropriate nutritional intervention, program and policy making to address specific needs of diabetics in Iraq.

1.4 Study Objective

This study aims to determine the factors associated with glycemic status among type 2 Diabetes Mellitus patients in Merjan Diabetes Centre, Iraq.

1.5 Specific Objectives

1. To determine the socio-demographic characteristics, medical characteristics, nutritional status (anthropometry, biochemical, clinical and dietary intake), dietary GI/GL, lifestyle behaviors (physical activity, smoking) of Iraqi patients with type 2 DM
2. To determine the glycemic status of Iraqi patients with type 2 DM
3. To determine the following relationship between:
   a. Socio-demographic factors and glycemic status.
   b. Medical characteristics and glycemic status
   c. Nutritional status (anthropometry, biochemical, clinical and dietary intake) and glycemic status.
   d. Dietary GI/GL and glycemic status
   e. Lifestyle behaviors and glycemic status of Iraqi patients with type 2 DM
4. To determine the contribution of socio-demographic factors, nutritional status factors, dietary GI/GL intake and lifestyle behaviors towards glycemic status of Iraqi patients with type 2 DM.
1.6 **Null Hypothesis**

1. There was no significant association between the following:
   a. Socio-demographic factors and glycemic status
   b. Nutritional status (anthropometry, biochemical, clinical and dietary intake) and glycemic status
   c. Calculated GI and GL, and glycemic status
   d. Lifestyle behaviours and glycemic status of Iraqi patients with type 2 DM
2. There was no significant contribution of socio-demographic factors, nutritional status factors, dietary GI/GL intake and lifestyle behaviours towards glycemic status of Iraqi patients with type 2 DM.

1.7 **Conceptual Framework**

Figure 1.1 shows the conceptual framework of the present study. The independent variables are socio-demographic characteristics (age, location, occupation, education level, ethnicity and income), medical background (characteristics and medical history, duration of diabetes treatment modalities and co-morbidities), Nutritional status (anthropometry, biochemical, clinical features, dietary intake), calculated dietary GI/GL and lifestyle behaviours (physical activity and smoking status). The dependent variable was glycemic status. The purpose of the present study was to determine the association between the independent and dependent variables among patients with type 2 DM in Merjan diabetic centre in Iraq. Besides, all the variables that are examined in this study, which determine four factors including SES, NS, GI/GL and physical activity, and their contribution to glycemic status (assessed by HbA1c).
Figure 1.1. Conceptual framework of factors associated with glycemic status
REFERENCES


Al-Ibrahim, A. A. H. (2012). Factors Associated with Compliance to Diabetes Self-Care Behaviors and Glycemic status Among Kuwaiti People with Type 2 Diabetes.


Badran, M., & Laher, I. (2011). Obesity in Arabic-Speaking Countries. Department of Pharmacology and Therapeutics, Faculty of Medicine, University of British Columbia, Vancouver, BC, V6T 1Z3, Canada.


CPG. (2009). Management of Type 2 Diabetes Mellitus. - Kementerian . *MOH/P/PAK/184.09(GU)*.


Frank B. Hu, M., PHD. Globalization of Diabetes The role of diet, lifestyle, and genes *Departments of Nutrition and Epidemiology, Harvard School of Public Health, Boston, Massachusetts*.


Huffman, B. (2014). Understanding a Type 2 Diabetes Diagnosis.


Junyi Jiang, Hua Qiu, Genming Zhao, Yi Zhou, Zhijie Zhang, Hong Zhang, . . . mail, W.-H. X. (October 16, 2012). Dietary Fiber Intake Is Associated with HbA1c Level among Prevalent Patients with Type 2 Diabetes in Pudong New Area of Shanghai, China. 10.1371/j.


Maryam S Farvid1, F. H., M Shokoohi1, A Fallah1 and Monir S Farvid3. (2014). Glycemic index, glycemic load and their association with glycemic status among patients with type 2 diabetes

Matthias B Schulze, Simin Liu, Eric B Rimm, JoAnn E Manson, Walter C Willett, a., & Hu, F. B. (2004). Glycemic index, glycemic load, and dietary fiber intake and incidence of type 2 diabetes in younger and middle-aged women1,2,3


Meenu, J., Jadeja Jayendrasinh, M., & Neeta, M. (2014). Correlation Between HbA1c Values And Lipid Profile In Type 2 Diabetes Mellitus. *TC (mg/dl), 147, 35.40.*


Urban, B. M. (August 2013). The Relationship Between Adiponectin To Leptin Ratio, Metabolic Dysfunction, And Diet In The Pediatric Obese The University of Utah.


