Factors Affecting Compliance of Patients with Diabetic Foot Ulcer Undergoing Hyperbaric Oxygen Therapy

Neveen Shaaban Mohamed[1] , Dr. OlaAbdel Aty Ahmed[2] and Dr. Zeinab Hussien Bakr[3]
Specialized Nurse at Aga Hospital[1], Professor of Medical Surgical Nursing[2] and Assist professor of Medical Surgical Nursing[3] , Faculty of Nursing , Ain Shams University

Abstract

Back ground: Diabetes is one of the most common and fastest growing diseases worldwide**.** Diabetic foot ulcers (DFUs) are a prevalent complication of diabetes mellitus and account for significant morbidity and mortality. Hyperbaric Oxygen Therapy (HBOT) is one of the advanced therapeutic modalities for wound management. **Aim:** the study aimed to assess factors affecting compliance of patients with diabetic foot ulcer undergoing hyper baric oxygen therapy**. Design:** descriptive exploratory design was utilized for conduct the current study. **Setting:** this study was carried out at hyper baric oxygen therapy at Nasser institute for research and treatment**. Study subjects:** A Purposive sample of 30 Patients with diabetic foot ulcer on hyper baric oxygen therapy. **Tools:** 1) patient interviewing questionnaire. 2) patient related factors questionnaire**.**3) Compliance assessment tools. **Results:** the patient had 50% satisfactory knowledge about diabetes, 93.3% of them the cost of treatment affect the family expenses**, 56, 7%** of them had severe social dysfunction, 43.3% of the studied patient had severe anxiety, 36. % of them had compliance toward therapy **Conclusion:** half of studied patients had satisfactory knowledge, highly significant positive correlation among total knowledge & total compliance. Highly significant negative correlation among total social & total compliance, statistically significant relation between total compliance and total social factor, monthly. Statistically significant relations between total compliance anxiety, environment factor and total knowledge, **Recommendation**: education program for diabetic foot ulcer, hyper baric oxygen therapy to the patient.

Key words: Diabetic foot ulcer, hyper baric oxygen therapy, compliance.

Introduction

Diabetes mellitus (DM) is a major public health problem that is determined with impaired carbohydrate metabolism, protein, and fat due to unstable insulin secretion, insulin resistance secretion, or both (**Mirzaei, et al., 2020**).

The skin in the diabetic patients are generally vulnerable to injury, and most injured skin are demonstrated as delayed wound healing or non-healing wound **(Gomes, et al., 2017).** Patients are not always able to identify the duration because of loss sensation and impaired vision patients with diabetes may experience nerve damage which can lead to weakness and numbness in the foot in addition to pain **(Felddman et al., 2017).**

Diabetic foot ulcers (DFU) are the most costly and serious complication for patients with Diabetes Mellitus (DM). Among patients with DM, 4% annually and up to one third in their entire lifetime may experience a DFU. The majority of DFU do not heal in a timely fashion and non-healing is associated with complications including skin, soft tissue, bone and systemic infection as well as the need for amputation **(Stratman, et al., 2020).**

Diabetic foot ulcer is one of the long term complications of diabetic mellitus with the life time risk up to 25%, yet many of the occurrences could be prevented. Even though preventive strategies have been shown to be cost-effective, diabetic foot ulcers still occur frequently and are a challenge for the individual and for the health system (**Armstrong et al., 2017).**

Hyperbaric Oxygen Therapy (HBOT) is one of the advanced therapeutic modalities for wound management. It has the specific potential to ameliorate tissue hypoxia, diminish

pathologic inflammation, and alleviates wound ischemia (**Alemayehu et al., 2019).**

Hyperbaric oxygen therapy involves intermittent administration of 100% oxygen, usually in daily sessions during each session; patients breathed pure oxygen at (1.4-3.0) absolute atmospheres during 3 periods of 30 min promoted fibroblast proliferation, collagen production, and angiogenesis. In addition, it was demonstrated that HBOT stimulated vasculogenic stem cell mobilization from bone marrow and recruited them to the skin wound **(Boet, et al., 2020).**

Without successful treatment, diabetic foot ulcers can eventually lead to amputation. 15% of diabetics will suffer foot ulcers at some point in their disease, and 80% of diabetes related amputations begin with these hard to heal ulcers **(Khan et al., 2017).**

In healthcare, the most commonly used definition of compliance is "patient's behaviors not only includes patient compliance with medication but also with diet, exercise, or life style changes. Compliance should be in different diseases and different patient populations to achieve certain desired outcomes which were part of the objectives in the management of the diseases or conditions **(Elsous et al., 2017).**

Patient compliance is essential for achieving successful, long term duration out comes in patients with DFU. There are many factors that effecting on patient compliance as Patient related factors include physical factors that affecting on administration of hyperbaric sessions, daily activity living**,** Cost of therapy and income are a crucial issue in patient compliance especially for patient with chronic disease as the treatment period could be lifelong **(Kang et al., 2018).** Psychological factors as anxiety and fears toward complication and amputation, Stress toward financial burden, sleeping disorder, feeling toward image disturbance affect negatively in patient compliance toward therapy **(Hazari & Maiya, 2020).** Environmental factors as noise, overcrowded, the HBOT chamber and waiting area affecting on patient compliance toward therapy (**Jain**, **Kewal, 2017**).

Nurses play a critical role in identifying, and evaluating change efforts in clinical practice. Outcomes are enhanced when nurses collaborate with all caregivers and cooperation of patients in the practice improvement initiative, community health nurses must use advanced decision-making strategies such as the nursing process, which combines judgment, action, responsibility, and accountability (**Nikitara, et al., 2019).**

Nurses can facilitate and positively influence wound healing by promoting collaboration and participating in assessment treatment and provide educational guide lines to these patients with professional health care team**.** The nurse duties involve ensuring safe conditions are meet and keeping patient comfortable due to high flammability of oxygen. Nurses remain in constant with patient helping them to remain relaxed and instructing them through breathing exercise to reduce risk of seizure from oxygen toxicity **(Alemayehu et al., 2019).**

Significance of the study:

Diabetes is now one of the most common non communicable diseases at the global level. It is the fourth or fifth leading cause of death in the most of the developed countries and is epidemic in many developing industrialized nations. It is estimated that today approximately 415 million adult have diabetes around 80%of these people live in developing countries. By 2030, the global estimate is expected to raise to about 642 million type 1 diabetes accounts for a small percentage of the total burden of diabetes in the population (**Piaggesi et al., 2018).**

Foot ulcer is a major complication of diabetes mellitus with high morbidity, mortality, and associated with costs. Foot ulcers are commonly infected with diabetic patients and have potential for cellulite progression. And if not treated quickly and appropriately, it leads to blood and gangrene infections, and sometimes leads to amputation. Therefore, it is necessary to

take precautionary measures against diabetic foot. That includes identifying people with foot ulcer risk factors, educating the patient and his fellows in the field of foot care and appropriate and comprehensive treatment of foot ulcer (**Madmoli et al., 2019)**.

The nursing management plan of a patient admitted to the hyper baric chamber involves various steps, these include: preparation of the session (both patient and equipment), intra-session monitoring, and evaluation of evolution of the wound. While preparing a patient for the HBOT session, the nurse is responsible for educating the patient and family on HBOT. This reduces the overall anxiety for the patient's experience. The patient and family education should also include indications and explanation on the duration of the session **(Yisak & Kiwannuka, 2019).**

Aim of The Study

The present study aimed **to** assess factors affecting compliance of patients with diabetic foot ulcer undergoing hyper baric oxygen therapy through assessing:

- Bio psychosocial factors that effect on compliance of patient with diabetic foot ulcer undergoing hyper baric oxygen therapy.
- Compliance of patients with diabetic foot ulcer undergoing hyper baric oxygen therapy.

Study questions:

- What are bio psychosocial factors that effect on compliance of patient with diabetic foot ulcer undergoing hyper baric oxygen therapy?
- What are factors affecting Compliance of patients with diabetic foot ulcer undergoing hyper baric oxygen therapy?

Subject and Methods

I-Technical design:

Research Design:

A descriptive exploratory design was utilized to conduct this study.

Setting:

The study was conducted at Nasser Institute Hospital (NIH) in hyper baric center.

Subjects:

Purposive sample of 30 Patients with diabetic foot ulcer on hyper baric oxygen therapy was selected to conduct this study through the following inclusion criteria: Conscious patient, patient diagnosed with diabetic foot ulcer. and both gender included.

Data for this study was collected by using the following tools:

Tool I- patients interview questionnaire.

It was designed in a simple Arabic language by the investigator after reviewing relevant and recent literature **(Armstrong, Jan et al., (2018) and Udedi et al., 2019)**. It included three parts:

Part 1:Socio–demographic data of patient

This part was used to assess socio demographic characteristics of the patient with diabetic foot ulcer patient. It consisted of 12 question regarding age, sex, marital status, residence, level of education, occupation, income, cost of treatment and sufficient of income per month from patients of point of view.

Part II: patient heath history:

This part was used to assess patient present, past history (e.g. onset of diabetics, signs &symptoms, complication of diabetes mellitus and diabetic foot ulcer causes, signs& symptoms and ways of treatment) and family history of patient consisted of three items (having relative suffering DM or other chronic disease & DFU& any amputation was happened to one of relatives.

Part III: knowledge assessment interview questionnaire.

It was developed by researcher based on literature review **Gittler (2016) (Poka & Taylor (2016) and Armstrong, et al., (2017)** was written in simple Arabic language. It used

to assess patients knowledge, include three parts:

Part 1: Included (8) MCQ questions to assess patient knowledge regarding diabetics mellitus (as definition, normal value for fasting blood sugar, causes, signs and symptoms, causes of coma, labs and complication and causes of complication).

Part II: Included (12) MCQ questions to assess patient knowledge regarding diabetic foot ulcer (definition, causes, risk of DFU, sign and symptoms, prevention, treatment of diabetic foot ulcer and self-care).

Part III: Included (5) MCQ questions to assess patient knowledge regarding hyper baric oxygen therapy as (definition, uses, number of sessions and complication of noncompliance toward therapy).

❖ **Scoring system:**

The total score of knowledge was twenty five grades. Each correct answer was given one grade and incorrect answer was given zero. The satisfactory score started from 70% and above and unsatisfactory was below 70%.

It was considered as follows:

- ≥70% was satisfactory level of knowledge when the total grads were ≥17.5 grades.
- <70% was unsatisfactory level of knowledge when the total grades were <17.5 grades.

Tool II- patient related factors questionnaire:

It was used to assess patient related factors of patient with diabetic foot ulcer undergoing hyper baric oxygen therapy through assessing physical, economic, social and environment factors.

1- Patient physical factors:

It was developed by researcher based on literature review (**Lambrinou, et al., 2019, Kim et al., 2020**) It was used to assess body system (respiratory factors, factor affecting on heart, blood vessels factors affecting on digestive system, affecting on nervous system factors affecting on renal, factors affecting on activities of daily living and factor affecting on hearing and stability.

❖ **Scoring system:**

- Yes, No It was consisted of (27) items, graded
- Yes→ 1
- No→ 0

2-Patient economic factors:

It was developed by researcher based on literature review **(Alaa, et al., 2012, Yip, 2015, Kang et al., 2018 and Lambrino, et al., 2019)** to assess economic status, cost effectiveness of each session, number of sessions, bearing all cost of treatment, effect of the treatment cost on family expenses and of livelihood effect appearing diabetic foot ulcer.

❖ **Scoring system:**

- Yes, No It was consisted of (7) items, graded
- Yes → 1
- No → 0

3- Social dysfunction rating scale:

It was adapted from **Matteson, et al., (1997).** It was used to assess social needs.it include three main items self-confidence, internal psychological system and performance.

❖ **Scoring system:**

The social dysfunction rating scale included 22 items, four responses for each items was ranged from1to 4 and classified as the following:

- None → 1
- Mild → 2
- Moderate → 3
- Severe → 4

The total score of the instrument is 88, the higher score is the higher social needs.it was considered that:

- No social dysfunction 1-22.
- Mild social dysfunction >23-44.
- Moderate social dysfunction >45-66.
- Severe social dysfunction >67-88.

4- Environmental factors: It was developed by researcher based on literature review **(Jain & Kewal, 2017, Bennich et al., 2017, Ghobadi et al., 2020).** It was assess ways for arrival, waiting list noise, traffic, the place of sessions, compliance with cleaning and disinfection and Ways of safety and security.

❖ **Scoring system:**

It was consisted of (10) items, three responses for each items was ranged always, sometimes, never and graded through the following:

- Always→ 3
- Sometimes→ 2
- Never→ 1

5-Hamiliton anxiety scale:

It was adapted from **Hamiliton (1960)**, which used to assess psychological factors of patient with diabetic foot ulcer patient.it elicited the patient subjective response.it rated the symptoms of anxiety, it included 14 items.it include anxiety and worries, tension, fears, insomnia and night mare, lack of concentration, depression, somatic symptoms, psych somatic, cardiac, respiratory, GIT and urinary symptoms and behaviors on speech.

❖ **Scoring system:**

The Hamilton anxiety rating scale included 14 items each item had 4 responses ranged from 1-4 as the following:

- None → 1
- Mild → 2
- Moderate → 3
- Severe → 4

The total score of the instrument is 56. It was graded as the following:

- Absent of anxiety → 1-12
- Mild of anxiety → 13-24
- Moderate of anxiety → 25- 42 Severe of anxiety → 43 – 56

Tool V- Compliance assessment tools:

Tools was adapted from **(Morskiy 2010)**, and modified by Investigator based on literature review **(Demirtaş & Akbayrak, 2017 and Ehwarieme et al., 2018)**, was concerned with assessment level of compliance through assessing patient compliance toward medication (8) questions, patient compliance toward self-care precautions and preventing complication (17) questions, patient compliance toward dietary system (16) questions, patient compliance toward daily activity (6) questions, patient compliance toward preventive precautions of bleeding and bacterial infection (16) questions and patient compliance toward hyper baric oxygen therapy (9) questions. All questions graded 5scores

- Always 5
- Often 4
- Sometimes 3
- Rarely 2
- Never 1

❖ **Scoring system:**

This tools consisted of (72) items that categorized as following:

Total score =252

- Medication included 8items = graded yes 1 / No 0
- Foot care and prevent complication 17 items = 85 marks - Nutrition 16 items =80 marks
- Daily activities 6 items =6 marks
- Prevention bleeding and bacterial infection 16 items =80 marks
- Hyper baric oxygen therapy 9 items =45 marks

Compliance ≥ 70 (≥ 230) grades and not compliance ≤ 70 **(≤ 230)** grades.

Administrative design:

An official written letter was issued from the faculty of nursing in Ain Shams University to the director of Nasser institute and to the director of nursing and hyper baric center super visors of the setting to obtain permission for data collection and help in conducting the study in their facility.

2- Operational design:

The Operational design includes preparatory phase, content validity and reliability, pilot study and field work.

A-Preparatory phase:

It included reviewing of related literatures and theoretical knowledge of various aspects of the study using books, articles and internet and magazines to develop tools of data collection.

B-Validity and Reliability:

Validity was tested through jury of (5) experts from Medical Surgical Nursing Department, Ain Shams University. The experts reviewed the tools for clarity, relevance, comprehensiveness, simplicity and applicability. Minor modification was done.

Reliability of the study tools: Testing reliability of the proposed tools was done statistically by Cronbach alpha test.

The reliability of the patient knowledge assessment tool Cronbach's alpha was 0.825, for factors affecting compliance assessment tools was 0.840 and compliance tool was 0.917.

Pilot study:

Pilot study was conducted on (5) patients of the patients under study to test the applicability clarity and efficiency of the tools, then the tools was Studied . Be modified according to the results of pilot, these patients involved in study.

Ethical consideration:

The ethical research considerations in this study included the following:

- The research approval was obtained from Scientific Research Ethical Committee in the Faculty of Nursing at Ain Shams University before starting the study.
- The researcher was clarified the objectives and aim of the study to the patient included in the study.
- The researcher assures maintaining confidentiality of the subject data.
- Patients informed that they are allowed to choose to participate or not in the study and that they have the right to withdraw from the study at any time.

Field Work:

To carry out the study, an approval obtained from hospital director and nursing director of Nasser institute for research and treatment. A letter was issued to them from the faculty of Nursing Ain Shams University explaining the aim of the study in order to obtain permission and cooperation to the study.

By interviewing the patient on hyper baric oxygen therapy, the aim of the study, component of tools and effect of the study on their activities were explained, and take their approval (oral consent) to participate in the study prior to any data collection.

Data was collected beginning from October 2018 to the end of October 2019.The researcher visited hyper baric oxygen therapy department at the research setting Tuesday, Wednesday and Thursday morning shift 9:00am –2:00pm.

Each patient was interviewed by researcher for about 30-45 minutes to be fulfilled in waiting area in hyper baric center before or after patient sessions first demographic data and clinical data, patient

sheet were collected from patient and knowledge took 10 minutes, factors affecting patient compliance took 15 minutes and compliance of patient with diabetic foot ulcer undergoing hyper baric oxygen therapy took 10 minutes.

V-Statistical Analysis

Data collected from the studied sample was revised, coded and entered using Personal Computer (PC). Computerized data entry and statistical analysis were fulfilled using the Statistical Package for Social Sciences (SPSS) version 22. Data were presented using descriptive statistics in the form of frequencies, percentages and Mean SD. A correlation coefficient "Pearson correlation" is a numerical measure of some type of correlation, meaning a statistical relationship between two variables.

Chi Square test statistic is commonly used for testing relationships between categorical variables.

Significance of the results:

- Highly significant at p-value < 0.01.
- Statistically significant was considered at p-value < 0.05
- Non-significant at p-value ≥ 0.05
- Total size of population 100
- n= N X p(1-p) ÷ [(N-1 x(d2 ÷ z2)+ p(1-p)]
  n :sample size
  N: population size
  z :z value "1.96"
  d : standard error
  p : 0.5
  Number of studied sample = 30 patients

Results:

Table (1): shows Distribution of the Studied Patients' According to their Socio-demographic Characteristics, it was observed that 70.0% of the studied patients their age ranged between 45 to less than 55 years with mean± SD 47.6±7.98 years, and 63.3% of them were males, moreover, 70.0 % of them had married and 53.3% of them living at urban. and 56.7 % occupied. 86.7% of them had insufficient Monthly income, moreover, 40% of them had health insurance coverage, and 56.7% of them had first responsible for the family, finally, 73.3% of them had less than 3 rooms in the house.

Table (2): Regarding this study total knowledge of studied patients 50% of them had satisfactory knowledge around diabetic information, 40% of them had satisfactory around diabetic foot ulcer, 60% of studied patients had un satisfactory around diabetic foot ulcer and 70% of them had unsatisfactory knowledge around hyper baric oxygen therapy.

Table (3): Distribution of the studied patients' regarding their Physical Factors, it was observed that respiratory factors, 56.7% of the Studied Patients had Suffer from frequent cold attacks, regarding to Factors affecting the heart and blood vessels, 70.0% of them had Suffer from cold extremities. Concerning with Factors affecting the digestive system, 63.3% of them Suffer from indigestion, and finally, 80.0% of them Suffer from numbness in their extremities from Factors affecting the nervous system.

Table (4): Distribution of the studied patients' regarding their Economic factors, it was indicated 93.3% & of the Studied Patients had Cost of treatment affect the family expenses & 83.3 % of them know the cost of each session.

Table (5): Distribution of the studied patients' regarding their environmental factors, it was presented that 73.3% of the studied patients had always " Is there room for wound dressing for diabetic foot ulcers", 50.0% of them had sometimes " commit to following up until the scheduled sessions end", however, 60.0% of them reported that never " find the environment work clean, calm and free from crowding".

Figure (1): Distribution of the Studied Patients' about their Total Social Dysfunction Scale, it was noticed that 56.7% of the Studied Patients had Severe social dysfunction, however, only 10.0% of them had No social dysfunction.

Figure (2): Distribution of the studied patients' about their Total Hamletin Anxiety Scale, it was noticed that 43.3% of the Studied Patients had severe of anxiety, 30% of them had moderate anxiety and 10.0%of them had Absent of anxiety.

Figure(3): Distribution of the studied patients' about their Total Compliance of Diabetic and Diabetic Foot Ulcer, it was showed that 36.7% of the Studied Patients had Compliance with of Diabetic and Diabetic Foot Ulcer, on other hand 63.3% had no compliance.

Table (6): Relation between Characteristics of the Studied Patients and their Total Knowledge regarding Diabetes and Diabetic Foot, it showed that highly statistically significant relation between Educational level & Residence and Total Knowledge at (p value ≤0.01). moreover, there statistically significant relation between Age & Gender and Total

Knowledge at (p value ≤0.05), while that No statistical significant relation between other socio-demographic characteristics at (P value >0.05).

Table (7): Correlation between Studied Variables, it was observed there positive correlate among total knowledge & total compliance, on other hand, negative correlation among total social dysfunction scale, total hamletin anxiety scale& total compliance.

Table (1): Socio-demographic characteristics (n=30).

Characteristics of studied patients'	N	%
Age		
35 :< 45	9	30.0
45: 55	21	**70.0**
$\bar{x}$S.D 47.6±7.98		
Gender		
Male	19	**63.3**
Female	11	36.7
Marital status		
Single	3	10.0
Married	21	**70.0**
Widowed	6	20.0
Residence		
Rural	14	46.7
Urban	16	**53.3**
Educational level		
Illiterate	2	6.6
Read/Write	3	10.0
Secondary	11	36.7
University	14	**46.7**
Job		
Working	17	**56.7**
Not working	13	43.3
Monthly income		
Sufficient	4	13.3
Insufficient	26	**86.7**
Having health insurance coverage		
Yes	12	40.0
No	18	**60.0**
Are the patient first responsible for the family		
Yes	17	**56.7**
No	13	43.3
Number of rooms in the house		
<3	22	**73.3**
>3	8	26.7

Table (2): Distribution of the Studied Patients' about their Total Knowledge regarding Diabetes and Diabetic Foot (n= 30)

Domains	Satisfactory		Unsatisfactory	
	N	%	N	%
Knowledge about diabetic	15	**50**	15	50
Diabetic foot Ulcer	12	40	18	**60**
Hyperbaric Oxygen Therapy	9	30	21	**70**

Table (3): Distribution of the Studied Patients' regarding their Physical Factors (n= 30).

Respiratory factors	**Yes**		**No**	
	N	**%**	**N**	**%**
pneumonia	0	0	30	100
rapid breathing	11	36.7	19	63.3
frequent cold attacks	17	56.7	13	43.3
cyanosis	6	20.0	24	80.0
Factors affecting the heart and blood vessels				
high blood pressure	18	**60.0**	12	40.0
cold extremities	21	**70.0**	9	30.0
bleeding at the site of the ulcer	14	46.7	16	53.3
discoloration of the skin	20	66.7	10	33.3
Factors affecting the digestive system				
indigestion	19	**63.3**	11	36.7
stomach pain accompanied by vomiting and vomiting	5	16.7	25	83.3
contraction of the esophagus during the swallowing process	7	23.3	23	76.7
obesity	9	30.0	21	70.0
Factors affecting the nervous system				
numbness in the extremities	24	**80.0**	6	20.0
decreased sensation in the extremities	22	73.3	8	26.7
erectile dysfunction	9	30.0	21	70.0
loss of sexual desire	13	43.3	17	56.7
muscle weakness	18	60.0	12	40.0
Suffer from short-sightedness	19	**63.3**	11	36.7
Factors that affect the kidneys				
frequent urination	23	**76.7**	7	23.3
swollen feet	19	63.3	11	36.7
itchy skin constantly	20	66.7	10	33.3
Factors affecting motor activity				
obesity	8	26.7	22	73.3
a previous foot ulcer	17	**56.7**	13	43.3
have difficulty moving and walking	16	53.3	14	46.7
Factors affecting hearing and balance				
have ear problems	7	23.3	23	76.7
feel a ringing in my ears	9	30.0	21	70.0
imbalance after sessions	11	**36.7**	19	63.3

Table (4): Distribution of the Studied Patients' regarding their Economic Factors (n= 30).

Items	**Yes**		**No**	
	N	**%**	**N**	**%**
The monthly income sufficient for the expenses of oxygen therapy sessions	4	13.3	26	86.7
Know the number of sessions scheduled for you	13	43.3	17	56.7
Know the cost of each session	25	**83.3**	5	16.7
Bear all the expenses of treatment	6	20.0	24	80.0
Take sick leave during the sessions	23	76.7	7	23.3
Cost of treatment affect the family expenses	28	**93.3**	2	6.7
Resource affected by the appearance of diabetic foot ulcers	19	63.3	11	36.7

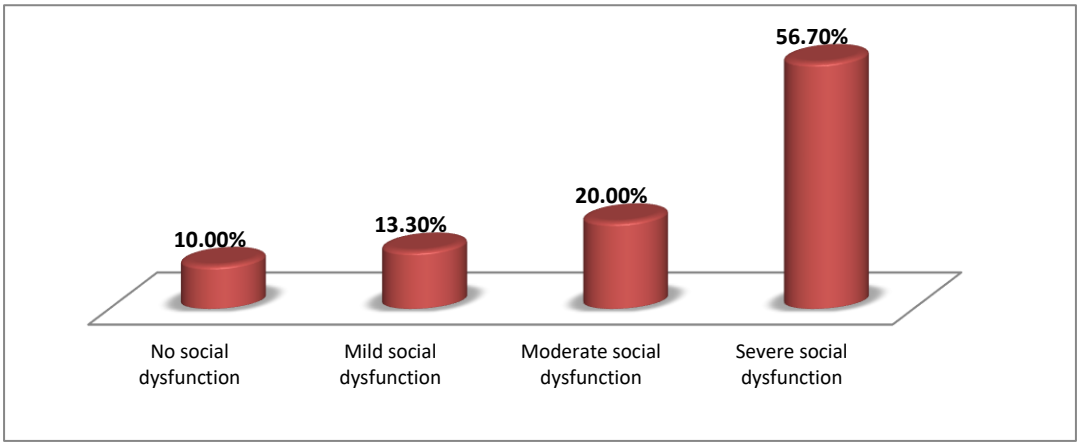

Figure (1): Distribution of the Studied Patients' about their Total Social Dysfunction Scale (n= 30).

Table (5): Distribution of the Studied Patients' Regarding their Environmental Factors (n= 30).

Items	Always		Sometimes		Never	
	N	%	N	%	N	%
long distance to reach the oxygen therapy	16	53.3	8	26.7	6	20.0
Have transportation to and from the hyperbaric oxygen therapy center	7	23.3	14	46.7	9	30.0
Suffer from waiting lists to attend sessions	6	20.0	13	43.3	11	36.7
there is good waiting area available in the HBOT center	9	30.0	13	43.3	8	26.7
Find the environment work clean, calm and free from crowding	3	10.0	9	30.0	18	**60.0**
Commit to following up until the scheduled sessions end	6	20.0	15	50.0	9	30.0
Find in the place adherence to the general rules of hygiene	5	16.7	12	40.0	13	43.3
Find in the medical team a commitment to cleanliness and disinfection of hands among patients	8	26.7	11	36.7	11	36.7
Is there room for wound dressing for diabetic foot ulcers	22	**73.3**	5	16.7	3	10.0
Are there safety measures available in the center like(the presence of guiding panels - a known escape exit - a fire extinguisher - activated alarms)	12	40.0	15	**50.0**	3	10.0

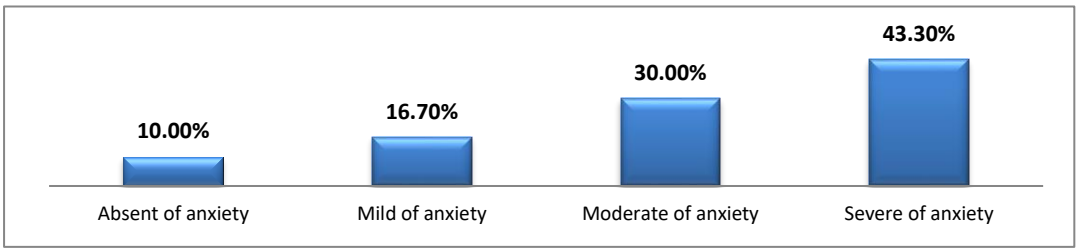

Figure (2): Distribution of the Studied Patients' about their Total Hamletin Anxiety Scale (n=30).

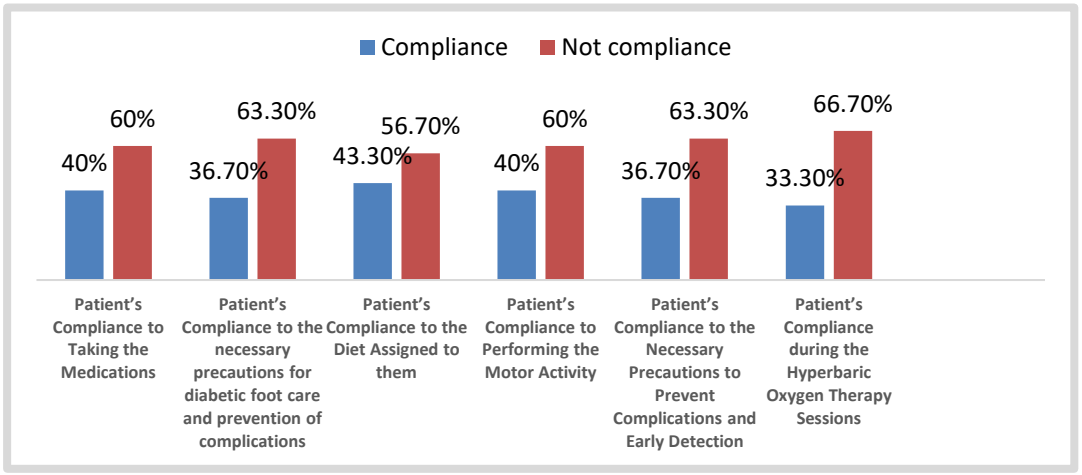

Figure (3): Distribution of Studied Patients' according to their Total Compliance of Diabetic and Diabetic Foot.

Table (6): Relation between Characteristics of the Studied Patients and their Total Knowledge regarding Diabetes and Diabetic Foot (n=30).

Items		Total Knowledge				X2	P-Value
		Satisfactory N=13		Unsatisfactory N=17			
		N	%	N	%		
Age	35 :< 45	8	61.5	1	5.9	3.949	.032*
	45: 55	5	38.5	16	94.1		
Gender	Male	4	30.8	15	88.2	4.001	.021*
	Female	9	69.2	2	11.8		
Marital status	Single	1	7.7	2	11.8	1.071	.068
	Married	8	61.5	13	76.4		
	Widowed	4	30.8	2	11.8		
Residence	Rural	1	7.7	13	76.5	5.999	.009**
	Urban	12	92.3	4	23.5		
Educational level	Illiterate	0	0	2	11.8	7.187	.005**
	Read/Write	0	0	3	17.6		
	Secondary	1	7.7	10	58.8		
	University	12	92.3	2	11.8		
Job	Working	7	53.8	10	58.8	1.945	.061
	Not working	6	46.2	7	41.2		
Monthly income	Sufficient	2	15.4	2	11.8	1.816	0.08
	Insufficient	11	84.6	15	88.2		
Having health insurance	Yes	5	38.5	7	41.2	2.101	.054
	No	8	61.5	10	58.8		

Table (7): Correlation between Studied Variables.

Items	Knowledge	social	Hamletin
1-Total knowledge			
2-Total social dysfunction scale	r -0.477 p .006**		
3- Total hamletin anxiety scale	r -. 812 p .001**	r 0.321 p .021*	
4-Total compliance	r 0.299 p .031*	r -0.517 p .003**	r- 0.321 p .021*

(**) Statistically significant at p<0.01

Discussion

Part I: Socio –demographic characteristics and health history of patients under the study

Regarding patients' demographic characteristics, the current study revealed that less than three quarters of the studied patients their age ranged between 45 to less than 55 years. This might be due to the most of the studied patients aged from forty five to fifty five or more years old. These results similar with the study performed by **Hegazy, et al. (2011**) entitled "Effect of Hyperbaric Oxygen Therapy on Quality of Life for Patients with Diabetic Foot Ulcers at Nasser institute in Cairo, Egypt". which found that more than two fifths of studied patients were between 40-<50 years Related to gender of the studied patient the finding of the current study revealed that, less than two third of studied patients were males, this might be due to increased risk of chronic disease related diabetes among men at the same age group in Egypt **Al-Mohaithef, et al. (2022)**. These results was dis agreement with the study performed by **Abu-elenin, et al., (2018)** entitled" Knowledge, Practice and Barriers of Foot Self-Care among Diabetic Patients at Tanta University Hospitals in Egypt". Which found that less than two third of studied patients were females.

Regarding to marital status, the finding of the current study revealed that less than three quarter of studied patient were married. This might be due to the most of the studied patients aged from forty to sixty or more years old. These results are accordance with the study performed by **Marzouk, et al. (2017)** which entitled "Foot Care Knowledge Assessment among Type 2 Diabetic Patients and found Attending Three Family Medicine Centers in Cairo". Which revealed that more than two third of the studied patient were married.

Concerning residence, the finding of the current study revealed that, more than half of studied patient residing in urban. These results are similar to the results of the study performed by **Gamal, et al. (2018)** entitled "Assessment of risk factors associated with diabetic foot Ulcers among diabetic patients attending Suez Canal University Hospitals". that found more than half of studied patients from urban. That could be explained by less than half of the patients was university education of patients and know important of seeking medical advice.

Regarding educational level of the studied patients, it was found that less than half of them had university education**.** This result was disagree with study **Marzouk, et al. (2017)** which found Minority were highly educated and the majority was illiterate.

Regarding the job of the studied patients, it was found more than half of them working; it might be due to more than half of them male and less than three quarter in the age of working. These result dis agree with **Mohamed et al., (2018**)"Nursing Guidelines for Patients with Diabetic Foot Awareness about Hyperbaric Oxygen Therapy "that found more than two fifth of that patients not working. Also, the finding of the current study revealed that majority of studied patient had insufficient monthly income and less than two third of that patients had not health insurance. These results might be due to more than of two fifth of them not working, increased health-care cost and loss of productivity. These results supported with the study done by **Marzouk, et al. (2016)** that found more than two fifth of the studied population reported inadequate income.

Part II: PT Total knowledge about diabetes, diabetic foot ulcer and hyper baric oxygen therapy

Concerning to patients total knowledge about diabetes more than half of the studied patient had satisfactory knowledge regarding "Diabetes mellitus is& Why diabetic patient was exposed to complication, less than two third of them had unsatisfactory knowledge regarding the causes of diabetes mellitus, this result might be due to less than two fifth of studied patient have secondary education and lack of guidance and instructions from the health care givers to those patients.

These results were in agreement with the study performed by **Mohammed, et al**. **(2018)** who revealed that two third of the patient had satisfactory knowledge about diabetes.

Regarding to total knowledge of patients about diabetic foot ulcer, the finding of the current study revealed that more than three quarter of studied patient had satisfactory knowledge regarding definition of diabetic foot ulcer, less than three quarter of studied patients had satisfactory level of knowledge regarding symptoms of diabetic foot ulcer. This result might be due to about two thirds of the studied patients were diagnosed for more than 10 years. These result was dis agree with the study performed by **Marzouk, et al. (2017)** that found more than two third of studied patients had unsatisfactory level of knowledge about diabetic foot ulcer.

Regarding to total knowledge of studied patients about the hyperbaric oxygen therapy, the finding of the current study revealed that less than three quarter had un satisfactory total knowledge about hyperbaric oxygen therapy. This result might be due more than half of these patients have secondary school.

These result was agree with study performed by **Mohamed, et al**. **(2018)** who revealed that most the studied patients have poor level of knowledge about hyperbaric oxygen therapy during the pre-test.

Part III: Factors affecting compliance of the patient with diabetic foot ulcer undergoing hyper baric oxygen therapy;

Regarding their Physical Factors, it was observed that majority of studied patients suffering from numbness in extremities this finding agree with study performed by **Gopal, (2020)** entitled **"**Assessment of cases of diabetic peripheral neuropathy in type II diabetes mellitus patients" who found that more than one third had numbness of limbs.

Regarding their physical factors it was observed that less than two third of studied patients suffering from high blood pressure this finding agree with study performed by **Yimam et al. (2021)** entitled "Prevalence of diabetic foot ulcer and associated factors among diabetic patient in Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia". that found more than one third had history of increased blood pressure, this might be due to effect of disease on blood vessels.

Regarding factors affecting motor activity of physical factors more than one quarter of them sever from obesity these result agree with other result performed by **Johnson, (2016)** entitled "compliance with the 2015 American Diabetes Association screening guidelines for diabetes Mellitus Type 2 in Primary Care" , that found two thirds of participants were obese. This might be due to more than half of this patients had difficulty in moving and walking, more than two fifth of them had sever lack of interest.

Regarding Economic factors that affecting on compliance of patient, the present study showed that the most of studied patients had cost of treatment effect on the family expenses, this result agree with study performed by **Kang, et al. (2018)** entitled "Cost-related medication non-adherence among US adults with diabetes". That found lack of financial resources such as patient who had no insurance cover, cost of medication too expensive or who had low income were more likely to be noncompliance to treatments. This might be due to long term therapy and cost of each session.

Regarding total social dysfunction scale, it was noticed that more than half of the studied patients had severe social dysfunction, these results agree with **Ramkisson et al., (2017)** entitled "Social support and coping in adults

with type 2 diabetes". that found an increase in social support is associated with a decrease in emotional distress. It might be due to fear from loss and withdrawal from society.

Regarding environmental factors, it was noticed that more than half of studied patient always suffering from long distance to reach the oxygen therapy that affecting on their compliance, these result agree **with Jin , et al.(2008)** entitled " Factors affecting therapeutic compliance: A review from the patient's perspective. Therapeutics and clinical risk management ". that found long waiting time for clinic visits, Lack of accessibility to healthcare , unhappy or unsatisfied clinic visits that effect on patient compliance, this might be due to more than two fifth of these patients live in rural and need time to reach the clinic.

Regarding total hamletin anxiety scale, it was noticed that more than two fifths of the studied patients had severe of anxiety, while only less than one fifth of them had absent of anxiety. This result might be due to loss of function and fear from any complication. The finding was dis agree with study performed by **Polikandrioti, et al. (2020)** entitled "Quality of life in diabetic foot ulcer: associated factors and the impact of anxiety/depression and adherence to self-care"**.** that found more than two third had low levels of anxiety.

Part V: compliance tools:

Regarding patient's compliance to taking the medications less than two third of the studied patients had no compliance toward medication, this result was agree with the study performed by **Waari, et al., (2018)** entitled "Medication adherence and factors associated with poor adherence among type 2 diabetes mellitus patients at Kenyatta National Hospital, Kenya". that found the most of studied patient with type 2 diabetes mellitus had unsatisfactory level of compliance toward medication. It might be due majority of the patient reported insufficient income, limited insurance coverage.

Regarding patient's compliance to the necessary precautions for diabetic foot care and prevention of complications less than two fifth of studied patients had compliance with diabetic foot care, less than two third of studied patients had not compliance with diabetic foot care, this result was disagree with the study performed by **Alshammari et al., (2019**) entitled" knowledge, attitude, and practice to diabetic foot care among patients attending a diabetic clinic in Riyadh, Saudi Arabia". that Found more than three quarter had good foot care practice. It might be due to more than two fifth of the studied patients had high level of education.

Regarding the study, patient's compliance to the diet assigned to them, the result of finding was more than half of studied patients had not compliance to diet, this result was agree with study performed by **Bonger, et al., (2018)** entitled "Adherence to diabetic self-care practices and its associated factors among patients with type 2 diabetes in Addis Ababa, Ethiopia". that found three quarter of the study participants did not adhere to recommended dietary management practices. It might be due to more than two third of them exposed to hypoglycemic coma and suffering from obesity.

According patient's compliance to performing the motor activity in this study less than two third of studied patient had no compliance, this result was agree with **Alhariri et al. (2017)** entitled "Descriptive study on the knowledge, attitudes and practices regarding the diabetic foot". who found that more than two third reported non-adherence to any exercise advices at all. It might be due disease process, more than one third of studied patient reported that muscle aches, more than two fifth of them loss of interest.

Regarding to patient's compliance to the necessary precautions to prevent complications and early detection more than one third of studied patients had compliance to the necessary precautions to prevent complications and early detection. These result are disagree with the study performed by **Alshammari et al. (2019**) that Found more than three quarter had good foot care practice. It might be due lack of education and knowledge deficit regarding their disease process.

Regarding patient's compliance during the hyperbaric oxygen therapy sessions, more than two third of studied patient had no compliance during the hyperbaric oxygen

therapy sessions, this might be due to lack of health educational mass campaigns about the HBOT and the way of treatment for diabetic foot.

These findings agree with **Mohamed, et al. (2018)** who reported that all patients in study had poor knowledge about instructions following the session of HBOT during pre-test.

Also, this finding is consistent with **Bhutani & Vishwanath, (2012)** who reported that; the nursing care for patients undergoing HBOT must primarily focus on patient education, patient monitoring, and the continuous evaluation of the healing process. Therefore, nurses should work with the interdisciplinary team, with the patient, and family to determine the educational needs and perform the relevant interventions.

Part VI: Relation and correlation between Characteristics of the Studied Patients and their Total Knowledge regarding diabetes and diabetic foot ulcer

Regarding to the relation between socio demographic characteristics of the studied patients and their total knowledge regarding diabetes and diabetic foot, it showed that highly statistically significant relation between educational level & residence and total knowledge at (p value ≤0.01). Moreover, there were statistically significant relation between Age & gender and total knowledge at (p value ≤0.05), while that statistical significant relation between other socio-demographic characteristics at (P value >0.05).

This result was agree with **Moraes et al. (2020) entitled** "data collection knowledge and self-care in diabetes mellitus and their correlations with socio demographic, clinical and treatment variables in a city in the interior of Minas Gerais, Brazil". Who found that knowledge correlated directly and statistically significantly with education (p=0.000) and with monthly family income (p=0.020), suggesting that the higher the education and income, the greater the knowledge about the disease. Income also showed a significant correlation with the performance of the dimension “general food” (p=0.040), which suggests that the higher the income. This result might be due to level of education affect positively on pt knowledge about disease and treatment.

Correlation between studied variables, it was observed there was highly significant positive correlation among Total knowledge & total compliance at p value <0.01**, on other hand, highly significant negative correlation among total social dysfunction scale & total compliance at p value <0.01**. This result might be due to good awareness of disease.

These results agree with study **Méndez et al., (2018**) entitled ". Knowledge, adherence to the treatment and prevalence of neuropathy in patients with type 2 diabetes mellitus ", who found that relationship between knowledge about the disease and adherence to treatment.it might be due to the patients with a higher educational level were more knowledgeable on diabetes. The findings indicated that the educational level of the subject could enhance their ability to learn about the diabetes.

There was significant relation between total compliance and total social dysfunction scale, this result was agree with **Miller& Dimatteo , (2013)** entitled "Importance of family/social support and impact on adherence to diabetic therapy. diabetes, metabolic syndrome and obesity". That found a positive and significant relationship between social support and adherence to diabetes treatment.

Regarding to relation between factors and total compliance there were highly significant relation between total compliance and total social factor and monthly income, this result was agree **with Kassahun et al., (2016)** entitled "Non adherence and factors affecting adherence of diabetic patients to anti-diabetic medication in Assela General Hospital, Oromia Region, Ethiopia" that found low income and low educational level were significantly associated with the level of adherence to the treatment regimen.

These results agree with **Lambrinou et al., (2019)** entitled "Lifestyle factors, self-management and patient empowerment in diabetes care". who found that absence of social support and disease-related implications, such as fatigue, are the main reasons for non-adherence .

There were statistical significant relation between total compliance and total knowledge in studied patients, this result was agree with **Taha, et al., (2011)** entitled "Factors affecting compliance of diabetic patients toward therapeutic management" who that found there were a highly positive correlation between knowledge and compliance of the study sample.it might be due to the lack of information is a major factor underlying lack of compliance.

There were statistical significant relation between total compliance and anxiety, this result agree with **Polikandrioti, et al., (2020**), who found that there were statistically significant relation associated with anxiety and depression, adherence to guidelines with Quality of life.

Conclusion

The results of this study concluded that:

Half of the studied patients had satisfactory knowledge about diabetes mellitus. Also two fifth of them had satisfactory knowledge about diabetic foot ulcers. More ever less than three quarter had unsatisfactory knowledge about hyper baric oxygen therapy. Factors had a crucial role in patients compliance as physical, economic, and environmental factors and psychological factors that affected on patient compliance.

There was highly statistically significant relation between educational level & residence and total Knowledge. Also, there was statistically significant relation between age & gender and total Knowledge while that was statistical insignificant relation between other socio-demographic characteristics, more ever there was highly significant positive correlation among total knowledge & total Compliance. There was highly statistically significant relation between total compliance and total social and monthly income, also highly statistically significant relation between total compliance and anxiety and total knowledge.

Recommendations

Based on findings of the present study, the followings are recommended:

-Action plan to educate patients newly diagnosed with diabetes about this disease and its complication.

1- Action plan to educate patients newly diagnosed with diabetes about this disease and its complication.
2- Educate patients with diabetic foot ulcers about importance of self-foot examination.
3- Educate patients the important of follow up instructions to facilitate improvement.
4- Providing a written instructions booklet about diabetic foot and hyperbaric oxygen therapy is of great importance for the patients
5- Organize regular counseling sessions for meeting the patient's information needs about diabetic foot and hyperbaric oxygen therapy and solving their problems by providing them with clear, full and accurate information in both verbal and written form
6- The nurses should educate the patient on use of products that may produce harmful vapors in the chamber such as body oils, perfumes, lotions, nail polish and deodorants. Other materials that should be avoided during an HBOT session include hearing aids, metal framed eyeglasses, contact lenses, jewelry, watches, dentures and other devices.
7- Provide nursing management plan that involves preparation of the session, intra-session monitoring, and evaluation of evolution of the wound.
8- Replication of the study on large numbers of such group of patients.

References

Aalaa, M., Malazy, O. T., Sanjari, M., Peimani, M., & Mohajeri-Tehrani, M. R. (2012). Nurses' role in diabetic foot prevention and care; a review. Journal of Diabetes & Metabolic Disorders,11(1), 1-6.

Abu-elenin, M. M., Elshoura, A. A., & Alghazaly, G. M. (2018). Knowledge, practice and barriers of foot self-care among diabetic patients at Tanta University Hospitals, Egypt. *Egypt J Community Med*, *36*(4), 94-102.

Alemayehu, Y., Kiwanuka, F., Muhamaddi, M., Imanipour, M., & Rad, S. A. (2019). Hyperbaric Oxygen Therapy: Indications, Benefits and Nursing Management. International Journal of Caring Sciences, 12(1).

Al-Hariri, M. T., Al-Enazi, A. S., Alshammari, D. M., Bahamdan, A. S., Al-Khtani, S. M., & Al-Abdulwahab, A. A. (2017). Descriptive study on the knowledge, attitudes and practices regarding the diabetic foot. *Journal of Taibah University medical sciences*, *12*(6), 492-496.

Alshammari, Z. J., Alsaid, L. A., Parameaswari, P. J., & Alzahrani, A. A. (2019). Attitude and knowledge about foot care among diabetic patients in Riyadh, Saudi Arabia. *Journal of family medicine and primary care*, *8*(6), 2089.

Al-Mohaithef, M., Abdelmohsen, S. A., Algameel, M., & Abdelwahed, A. Y. (2022). Screening for identification of patients at high risk for diabetes-related foot ulcers: a cross-sectional study. Journal of International Medical Research, 50(3), 03000605221087815.

Armstrong, D. G., Boulton, A. J., & Bus, S. A. (2017). Diabetic foot ulcers and their recurrence. New England Journal of Medicine, 376(24), 2367-2375.

Bhutani, S., & Vishwanath, G. (2012). Hyperbaric oxygen and wound healing. *Indian Journal of Plastic Surgery*, *45*(02), 316-324.

Boet, S., Martin, L., Cheng-Boivin, O., Etherington, N., Louge, P., Pignel, R., ... & Bennett, M. (2020). Can preventive hyperbaric oxygen therapy optimise surgical outcome? A systematic review of randomised controlled trials. European Journal of Anaesthesiology| EJA, 37(8), 636-648.

Bonger, Z., Shiferaw, S., & Tariku, E. Z. (2018). Adherence to diabetic self-care practices and its associated factors among patients with type 2 diabetes in Addis Ababa, Ethiopia. Patient preference and adherence, 12, 963.

Ewais, E., A Ahamed, M., & H Farahat, N. (2021). Diabetic Foot-related Knowledge, Health Beliefs and Practices among Diabetic Elderly. Egyptian Journal of Health Care, 12(4), 302-317.

Gamal, S., El-Deib, A. R., Khalil, F. A., Khalil, K. A., Omar, S. A., Abdou, M. M., & Sliem, H. (2018). Assessment of Risk Factors Associated with Diabetic Foot Ulcers among Diabetic Patients Attending Suez Canal University Hospitals. Journal of Advances in Medicine and Medical Research, 1-8.

Gopal, A. (2020). Assessment of cases of diabetic peripheral neuropathy in type II diabetes mellitus patients. *Journal of Advanced Medical and Dental Sciences Research*, *8*(11), 185-188.

Hamilton, M. (1960). The Hamilton Depression Scale—accelerator or break on antidepressant drug discovery. *Psychiatry*, *23*, 56-62.

Hazari, A., & Maiya, G. A. (2020). Patient's Perspective on Diabetic Foot Syndrome. In *Clinical Biomechanics and its Implications on Diabetic Foot* (pp. 33-37). Springer, Singapore.

Hegazy, S. M., Mourad, G. M., Zaki, R. A., & Emam, H. H. (2011). Effect of Hyperbaric Oxygen Therapy on Quality of Life in Patients with Diabetic Foot Ulcers. *Journal of American Science*, *7*(10), 168-174.

Jain, Kewal. (2017). Physical, physiological, and biochemical aspects of hyperbaric oxygenation. In *Textbook of hyperbaric medicine*.Springer,Cham pp11-22

Demirtaş, A., & Akbayrak, N. (2017). Development of an assessment scale for treatment compliance in type 2 Diabetes Mellitus in Turkish population: Psychometric evaluation. International journal of nursing sciences, 4(3), 244-251.

Ehwarieme, T. A., Chukwuyem, E. N., & Osayande, C. O. (2018). Knowledge of and compliance with therapeutic regimens among hypertensive patients in Nigeria. Africa Journal of Nursing and Midwifery, 20(1), 23-pages.

Elsous, A., Radwan, M., Al-Sharif, H., & Abu Mustafa, A. (2017). Medications adherence and associated factors among patients with type 2 diabetes mellitus in the Gaza Strip, Palestine. Frontiers in endo-crinology, 8, 100. https://doi.org/10.3389/fendo.2017.00100

El-Khawaga, G., & Abdel-Wahab, F. (2015). Knowledge, attitudes, practice and compliance of diabetic patients in Dakahlia, Egypt. Euro J Res Med Sci, 3(1).

Feldman, E. L., Callaghan, B. C., Pop-Busui, R., zochodne, D.W, Wright, D. E., Bennett, D. L. & Viswanathan, V. (2019). Diabetic neuropathy. Nature reviews Disease primers, 5(1), 1-18.

Gittler M. (2016): Lower limb amputations. In: Frontera WR, Silver JK, Rizzo TD, eds. Essentials of Physical Medicine and Rehabilitat1on. 3rd ed. Philadelphia, PA: Elsevier Saunders; chap 119.

Ghobadi, A., Sarbarzeh, P. A., Jalilian, M., Abdi, A., & Manouchehri, S. (2020). Evaluation of factors affecting the severity of diabetic foot ulcer in patients with diabetes referred to a diabetes centre in Kermanshah. Diabetes, metabolic, Syndrome and Obesity: Targets and Therapy, 13, 693 https://diabetesatlas.org/en/

Gomes, A., Teixeira, C., Ferraz, R., Prudêncio, C., & Gomes, P. (2017). Wound-healing peptides for treatment of chronic diabetic foot ulcers and other infected skin injuries. Molecules, 22(10), 1743.

Jin, J., Sklar, G. E., Oh, V. M. S., & Li, S. C. (2008). Factors affecting therapeutic compliance: A review from the patient's perspective. Therapeutics and clinical risk management, 4(1), 269.

Johnson, K. L. (2016). Compliance with the 2015 American Diabetes Association Screening Guidelines for Diabetes Mellitus Type 2 in Primary Care.

Kang, H., Lobo, J. M., Kim, S., & Sohn, M. W. (2018). Cost-related medication non-adherence among US adults with diabetes. *Diabetes research and clinical practice*, *143*, 24-33.

Ka kassahun, A., Fanta Gashe, E. M., & Rike, W. A. (2016). Nonadherence and factors affecting adherence of diabetic patients to anti-diabetic medication in Assela General Hospital, Oromia Region, Ethiopia. Journal of pharmacy & bioallied sciences, 8(2), 124.

Khan, Y., Khan, M. M., & Farooqui, M. R. (2017). Diabetic foot ulcers: a review of current management. International Journal of Research in Medical Sciences, 5(11), 4683-4689.

Kim, E. J., & Han, K. S. (2020). Factors related to self-care behaviours among patients with diabetic foot ulcers. Journal of Clinical Nursing, 29(9-10), 1712-1722.

Lambrinou, E., Hansen, T. B., & Beulens, J. W. (2019). Lifestyle factors, self-management and patient empowerment in diabetes care. *European journal of preventive cardiology*, *26*(2_suppl), 55-63

Madmoli, M., Madmoli, Y., Taqvaeinasab, H., Khodadadi, M., Darabiyan, P., & Rafi, A. (2019). Some influential factors on severity of diabetic foot ulcers and Predisposing of limb amputation: A 7-year study on diabetic patients. *International Journal of Ayurvedic Medicine*, *10*(1), 75-81.

Marzouk, D., El-Hilaly, R. A., Sos, D. G., & Fakkar, N. (2017). Foot Care Knowledge Assessment among Type 2 Diabetic Patients attending Three Family Medicine Centers in Cairo. *The Egyptian Journal of Community Medicine*, *35*(3), 43-53.

Matteson, M A, Connell, E S &linton. A. D (1997) Gerontogical nursing accept and practice 2 th ed. USA: W:B Saunders company pp.98.

Mirzaei, M., Rahmaninan, M., Mirzaei, M., & N adjarzadeh, A. (2020). Epidemiology of diabetes mellitus, pre-diabetes, undiagnosed and uncontrolled diabetes in Central Iran: results from Yazd health study. BMC Public Health, 20(1), 1-9.

Moraes, N. M., Souza, G. F. P., Brito, F. I., Antonio Júnior, M. E., Cipriano, A. E., Costa, N. S. V., ... & Gomes, L. C. (2020). Knowledge and self-care in diabetes mellitus and their correlations with sociodemographic, clinical and treatment variables. *Diabetes*, *6*, 1-6.

Nikitara, M., Constantinou, C. S., Andreou, E., & Diomidous, M. (2019). The role of nurses and the facilitators and barriers in diabetes care: a mixed methods systematic literature review. *Behavioral sciences*, *9*(6), 61.

Iacopi, E., Riitano, N., & Goretti, C. (2018). The organization of care for the diabetic foot syndrome: a time-dependent network. In The Diabetic Foot Syndrome. Karger Publishers. Vol. 26, pp. 83-96

Polikandrioti, M., Vasilopoulos, G., Koutelekos, I., Panoutsopoulos, G., Gerogianni, G., Babatsikou, F., ... & Toulia, G. (2020). Quality of life in diabetic foot ulcer: associated factors and the impact of anxiety/depression and adherence to self-care. *The international journal of lower extremity wounds*, *19*(2), 165-179.

Ramkisson, S., Pillay, B. J., & Sibanda, W. (2017). Social support and coping in adults with type 2 diabetes. *African Journal of Primary Health Care and Family Medicine*, *9*(1), 1-8.

Stratman, S., Schneider, C., & Kirsner, R. S.(2020). New Therapies for the Treatment of Diabetic Foot Ulcers: Updated Review of Clinical Trials. *Surgical technology international*, *37*.

TAHA, N. M., Abd El-Azeaz, M. A. G. D. A., & ABD EL- RAZIK, B. G. (2011). Factors affecting compliance of diabetic patients toward therapeutic management. Diabetes, 5, 6.

Taylor BC and Poka A. (2016): Osteomyoplastic Transtibial Amputation: The Ertl Technique. J Am Academic Ortho Surg. Apr. 24 (4):259-65.

Udedi, M., Muula, A. S., Stewart, R. C., & Pence, B. W. (2019). The validity of the patient health Questionnaire-9 to screen for depression in patients with type-2 diabetes mellitus in non-communicable diseases clinics in Malawi. *BMC psychiatry*, *19*(1), 1-7.

Waari, G., Mutai, J., & Gikunju, J. (2018). Medication adherence and factors associated with poor adherence among type 2 diabetes mellitus patients on follow-up at Kenyatta National Hospital, Kenya. *Pan African Medical Journal*, *29*(1), 1-15.

Yimam, A., Hailu, A., Murugan, R., & Gebretensaye, T. (2021). Prevalence of diabetic foot ulcer and associated factors among diabetic patient in Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia. International Journal of Africa Nursing Sciences, 14, 100285.

Yip, W. L. (2015). Influence of oxygen on wound healing. International wound journal, 12(6), 620-624.

Yuksel, M., & Bektas, H. (2021). Compliance with treatment and fear of hypoglycaemia in patients with type 2 diabetes. Journal of Clinical Nursing, 30(11-12), 1773-1786.