

## Effect of a Nursing Care Bundle on Severity of Diabetic Peripheral Neuropathy

Amna Abdullah Desouky<sup>1</sup>, Madiha Ali Mohammed<sup>2</sup>, Mohammad Hasan Mohammad Abdellah<sup>3</sup> & Samia Youssef Sayed<sup>4</sup>

<sup>1</sup>. Assistant Professor of Medical Surgical Nursing, Faculty of Nursing, Assiut University, Egypt.

<sup>2</sup>. Assistant Professor of Medical Surgical Nursing, Faculty of Nursing, Assiut University, Egypt.

<sup>3</sup>. Lecturer of Internal Medicine, Faculty of Medicine, Assiut University, Egypt

<sup>4</sup>. Assistant Professor of Medical Surgical Nursing, Faculty of Nursing, Assiut University, Egypt.

### Abstract:

**Background:** Diabetic peripheral neuropathy is a chronic microvascular complication of diabetes which can lead to foot ulcers, amputations, and mortality. Based on the current evidence-based practice; providing a care bundle can improve patient outcome. So, this study aimed to evaluate the effect of a nursing care bundle on severity of diabetic peripheral neuropathy. **Methods/Design:** Quasi-experimental single group pre- posttest design was utilized. A purposive sample of sixty-two diabetic attendees (new and established patients) to the Center of diabetes & endocrinology at Assiut University Hospital had been assessed at baseline using the following tools: Patient assessment sheet, Diabetic Self Care Knowledge Questionnaire (DSCK30Q), and Clinical neurological examination (CNE) scale. Then after receiving a care bundle, participant had been reassessed after three months later. **Results:** revealed that there was no statistically significant difference between baseline and follow-up measurements regarding neuropathy stage. Moreover, there was a highly statistically significant improvement in tested variables after receiving a care bundle with P-value <0.01. HgbA1c level was 10.56 (2.83) at baseline, while it was 8.83(1.75) at follow-up. The mean of total diabetic self-care knowledge was 10.43 (3.71) at baseline, while it was 20.93(4.76) at follow-up. Regarding neuropathy severity; (88.7%) have mild level at baseline, while (91.9%) have at follow-up. **Conclusion/Recommendation:** Diabetic peripheral neuropathy care bundle led to a targeted positive outcome as it maintained on the stage of diabetic peripheral neuropathy and didn't progress to the next stage. Also, severity of symptoms had been decreased in some patients/Diabetic peripheral neuropathy care bundle should be an integral part of diabetes care.

**Keywords:** Care bundle, Diabetic Peripheral Neuropathy & Severity.

### Introduction

Diabetic neuropathy is the most common microvascular and long-term complications among people with diabetes. Patients with diabetes can present with peripheral, central and/or autonomic nervous systems neuropathy. The estimated prevalence of peripheral neuropathy among adults with diabetes in the United States (US) is 28% (Pop-Busui et al., 2017). Diabetic peripheral neuropathy (DPN) is defined as, "the presence of symptoms and/or signs of peripheral nerve dysfunction after the exclusion of other causes". It affects up to half (50%) of patients with diabetes in Egypt (Mohamed et al., 2018).

A staging system has been described by Boulton et al., 1998, as a framework for diagnosis and management of DPN. It was classified into four grades as follow: stages 0/1: no clinical neuropathy; no symptoms or signs), stage 2: clinical neuropathy (chronic painful, acute painful, painless with complete/partial sensory loss and diabetic amyotrophy), stage 3: late complications of clinical neuropathy including foot lesions, e.g., ulcers,

neuropathic deformity, e.g., Charcot joint and non-traumatic amputation.

Manifestations of diabetic peripheral neuropathy (DPN) often start at the distal ends of the longest nerves and moves proximally. Causing nerve damage in the extremities particularly the feet; although in some severe cases the hands may also be affected. (Papanas, 2019) DPN of the limbs may involve large-fiber nerves (more related to touch, vibration, position perception and muscle control) small-fiber nerves (more related to thermal perception, pain and autonomic function) or both.

Early diagnosis of DPN is recommended and is the key factor for a better prognosis. The diagnosis of DPN is based on medical and neurological history. However up to 50% of patients may be asymptomatic. Frequently reported symptoms in DPN could be positive (painful) symptoms or negative (non- painful) symptoms. Various screening tools such as clinical neurological examination tool (CNE) can confirm the diagnosis (Bondor et al., 2019).

Treatment and management of DPN aims to improve peripheral nerve senses as well as blood glucose

control. DPN can be significantly reduced by optimal glycemic control and lifestyle modifications including: Healthy diet, physical exercise, reduction of exposure to toxins, smoking cessation, stress management, and foot care (Kassar & Khudur, 2021).

Many complications may arise due to DPN; worldwide DPN is a leading cause of disability (Qureshi et al., 2017), and it affects the quality of life due to chronic pain, high risk of falls, foot ulceration, and limb amputation. Furthermore, DPN symptoms often lead to sleep disorders, anxiety, and depression (Kioskli et al., 2019).

Nursing care bundles are a set of three to five evidence-based practices performed collectively and reliably to improve the quality of care and patient outcome (Lavalley et al., 2017). Diabetic nurse has an important role in bundles implementation and compliance. The American Diabetic Association recommend bundles intervention for patients with neuropathy as it is cost-effective and may reduce the risk of complications (American Diabetes Association, 2022).

### Significance of the study:

Diabetic peripheral neuropathy (DPN) places a large load on healthcare budgets (Amara et al., 2019). If patients with DPN progressed to diabetic foot, any foot lesion taking place as a result of diabetes and its complications; makes the costs of long-term treatment much heavier, but if DPN could be discovered in the early stage, better glucose control might prevent the development of clinical neuropathy and reduce nerve conduction and vibration threshold defects. So, it was very important to provide such a care bundle to those patients to maintain the stage of their condition, and /or decrease its severity.

### Aim of the study:

Evaluate the effect of a nursing care bundle on severity of diabetic peripheral neuropathy.

### This will be achieved through the following objectives:

- Assess DPN related variables (diabetic self-care knowledge, self-care practices, HgbA1c and post prandial blood glucose) before implementing a nursing care bundle.
- Assess the stage and severity of diabetic peripheral neuropathy “DPN” before implementing a nursing care bundle.
- Design and implement a diabetic peripheral neuropathy nursing care bundle.
- Evaluate the effect of implementing a nursing care bundle on DPN related variables such as diabetic self-care knowledge, self-care practices, HgbA1c and post prandial blood glucose.

- Evaluate the effect of implementing a nursing care bundle on the stage and severity of diabetic peripheral neuropathy.

### Hypotheses:

**H1:** The studied patients will maintain their DPN stage and will not progress to the next stage with respect to a nursing care bundle delivered.

**H2:** It will be a highly statistically significant differences in selected variables after receiving the nursing care bundle than before.

## Patients and Methods

### Research design:

Quasi-experimental, single group pre- posttest design was utilized in the study.

### Study variables:

The independent variable was diabetic peripheral neuropathy care bundle. While the dependent variables were the severity of peripheral neuropathy and some DPN related variables.

### Operational definitions:

#### Diabetic peripheral neuropathy nursing care bundle:

The care bundle was specific to diabetic peripheral neuropathy which consisted of a set of three elements about “(1) Diabetic peripheral neuropathy basic knowledge, (2) glycemic control measures, and (3) foot care according to American Diabetic Association standards of care (ADA, 2022) that had been conducted collectively and reliably using bundled approach: mixing methods of presentation (teaching and training) and mode of delivery was (face-to-face and/or phone).

#### DPN severity:

The progression of DPN signs and symptoms from mild and /or moderate score to sever score as measured by clinical neurological examination (CNE) scale.

#### Setting:

This study was conducted in center of diabetes & endocrinology in department of internal medicine at Assiut University Hospital.

#### Sample:

According to Assiut University Hospital record, (2021); about 410 patients diagnosed with DPN. A purposive sample of sixty-two (62) diabetic attendees (new and established patients) who were receiving medical care in center of diabetes & endocrinology at Department of Internal Medicine Assiut University Hospital. Fulfilling the **following criteria:** Age ranged from 18- 65 years, males and females, DM type I or II, have diabetic peripheral neuropathy (DPN), lower limb affection, and are willing to participate in the study. **Exclusion criteria:** Neuropathy due to trauma, malignancy, and vitamin B12 deficiencies were excluded, also factors that may

interfere with neurological condition other than DPN were excluded too and females who being pregnant.

**Sample size:**

The sample size was calculated based on a study carried out by **Ahrary et al. (2020)** By estimating an effect size 0.51, based on the mean symptom of the neuropathy decreased significantly in the trial group (mean (SD) =3.26 (2.80)) compared with control group (9.57 (3.21),  $P < 0.001$ ) and statistical power of 90%, level of confidence (1-Alpha Error): 95%, Alpha 0.05, Beta 0.1. The sample size determines at group is 56 patients. Considering 10% sample attrition (6 patients), the final sample size in the group is 62 patients. Sample size was calculated using test comparing two means through Kane SP. sample size calculator (**Rosner, 2011**).

**Tools for data collection:****Tool I: Patient assessment sheet**

This sheet was developed by researcher based on national and international literature review (**Mohmed et al., 2018; Amara et al., 2019; Sallam & Edison, 2019**) to assess the following parts:

**Part 1: Demographic data:**

This part assessed patients' demographic data as age, gender, marital status, residence, occupation, and educational level.

**Part 2: Clinical data:**

This part assessed clinical data of studied patients as: Body mass index(BMI), experience of diabetes, type, duration, and treatment of diabetes, co-morbid conditions as hypertension, associated medical conditions as retinopathy and nephropathy, and if received information about diabetes self-care or not.

**Part3: Self-care practices:**

This part was concerned with self-care practices of diabetic patients with peripheral neuropathy such as diet, physical activity, and blood glucose self-monitoring.

**Part4: Laboratory investigations:**

This part was concerned with laboratory investigation as: HgbA1c & post-prandial blood glucose measuring.

**Tool II: Diabetic self-care knowledge questionnaire DSCKQ-30 Questions:**

This questionnaire was adopted from (**Adibe et al., 2011**) to assess knowledge of diabetic patients about three domains; first: Modifiable lifestyle (1-18Q), second: Adherence to diabetic self-care (19-26Q) and the third about consequence of uncontrolled blood sugar level (27-30Q). The questionnaire was validated with Cornbrash's alpha of 0.967; the relevance of all items of the questionnaire was checked, and it was translated into Arabic language by a language expert to be used in this study.

**Scoring:**

Participants who answered correctly more than or

equal to 70% of questions considered having good self-care knowledge. On the contrary, those who answered correctly less than 70% of questions considered having poor self-care knowledge.

**Tool III: Clinical neurological examination (CNE) scale:**

This is a clinical scoring system adopted from (**Valk et al., 1992**) to assess severity of DPN. It measures sensory signs and reflexes in the lower limbs. It involves clinical testing of sensory dysfunction (pinprick, light touch, vibration, and position sense) of the feet, the anatomic level below which light touch sensation is impaired, muscle strength of the feet and ankle reflexes. The clinical tests were carried by medical researcher as follows

**Pinprick sensation:** A disposable safety pin was applied just proximal to the toe nail on the dorsal surface of the great toe (hallux) with just enough pressure. Inability of the patient to perceive a pinprick over either hallux was regarded as an abnormal test. The test is scored as the following: normal= 0, impaired in comparison with proximal sensation (for position sense, comparison between the first toe and the first finger) = 2, and absent= 4.

**Light touch sensation:** Patients were instructed to close the eyes and to say yes when they feel the touch. With the tip of index finger or a cotton ball, light sequential touches were applied to the tips of the first, third, and fifth toes of both feet for 1-2 seconds. The test was scored as the following: normal= 0, impaired in comparison with proximal sensation (for position sense, comparison between the first toe and the first finger) = 2, and absent= 4.

**Vibration testing by using 128-Hz tuning fork:** The tuning fork was applied to the bony prominence on the dorsal aspect of the first toe immediately proximal to the nail bed. For each vibration the patient feels or perceives it is considered "on" and for each time the patient feels or perceives that the tuning fork vibration has been stopped it is considered "off". One point is assigned for each time the patient reports the tuning fork is "on" or "off". The procedure was done in a randomized manner so that the patient cannot anticipate where the tuning fork will be applied. The test is positive if the patient correctly answers at least two out of three applications and negative if two out of three answers are incorrect. The test is scored as follows: normal= 0, impaired in comparison with proximal sensation (for position sense, comparison between the first toe and the first finger) = 2, and absent= 4.

**Sensitivity to position:** The patient is asked to close both eyes. Then the patient's toe is held on the lateral sides and moves it up or down. The patient is asked to tell the direction toward which the toe is moved. The test is repeated on the other side. The test is scored as

follows: normal= 0, impaired in comparison with proximal sensation (for position sense, comparison between the first toe and the first finger) = 2, and absent = 4.

**Anatomic level below which light touch sensation is impaired:** The patient is asked to close both eyes. Make lightly sequentially touches, with the tip of index finger or cotton ball, the tips of the feet. The patient is asked to inform when light touch sensation is impaired. The test is scored as follows: normal=0, toe=1, mid-foot= 2, ankle=3, mid-calf=4, and knee= 5

**Muscle strength:** To assess extensor hallucis longus muscles, patient is instructed to assume in the supine or sitting position. Metatarsal phalangeal and inter phalangeal joints of the big toe are extended. Pressure is made against dorsal surface of distal phalanges of the big toe in the direction of flexion. The test is scored as follows: normal= 0, impaired in comparison with proximal sensation (for position sense, comparison between the first toe and the first finger) = 2, and absent= 4.

**Ankle reflexes:** The patient is asked to knee on the edge of a high-backed, stable chair with his or her back toward. Gentle pressure is applied on the sole of the foot (causing some dorsiflexion and muscle stretching). The Achilles tendon is stroked and observed for plantar flexion of the foot via muscle contraction of the gastrocnemius and soleus muscles. The test is scored as follows: normal= 0, impaired in comparison with proximal sensation (for position sense, comparison between the first toe and the first finger) = 2, and absent= 4.

#### **Scoring:**

The maximal score of the CNE is 33 points. A total score of zero can be graded as no neuropathy, one to nine (1:9) as mild, (10: 18) as moderate, and (19: 33) as severe DPN.

#### **Diabetic peripheral neuropathy nursing care bundle:**

The care bundle is a set of three nursing care elements targeting diabetic patients who have peripheral neuropathy using standard Arabic language. It was developed by researchers according to **American Diabetes Association standard care (2022)**. It had been conducted by researchers in a teaching room at the center of diabetes & endocrinology. Three basic elements constitute the bundle:

The **first element** is the base of the bundle which concerned with “DPN related knowledge”: definition, risk factors, signs & symptoms, management, complications, and how to prevent the progression of DPN severity.

**Second element** concerned with glycemic control measures: is the core of this bundle which consisted of interrelated modifiable risk factors as diet “making healthy food choices” physical activity, medication,

stress management, self-monitoring, adherence to medication, and regular follow-up.

The **third element** concerned with foot care and ankle exercises. This element adopted the guidance stated by **Bus et al., (2016)** for prevention of foot ulcer which included the following (1) instructing patients to inspect their feet and the inside of shoes daily, wash feet daily (with careful drying, particularly between toes), avoid using chemical agents or plasters to remove calluses or corns, avoid cutting calluses or blisters without supervision, use emollients to lubricate dry skin, and cut toe nails straight across; (2) instructing patients to use socks without elastic and sewing; (3) instructing patients to avoid walking barefoot or wearing shoes without socks or slippers and to seek medical assistance whenever identifying problems in their feet; and (4) encouraging the patient to adhere to this foot-care advice. The bundle was formulated and brought to patients in sessions. The time allocated for all sessions was about 3 hours.

#### **Procedure:**

To accomplish the aim of study; it passed through the following phases.

#### **Preparatory phase:**

#### **Tools development:**

It included reviewing the updated national (**Mohmed et al., 2018; Amara et al., 2019; Sallam & Edison, 2019**) and international (**Saltar & Sahar, 2020; Bairaktaridou et al., 2021; Ziegler et al., 2021; Gilory et al 2020**) to develop tools for data collection.

#### **Content validity:**

It was done by a panel of seven professional health care providers including six faculty members of Medical Surgical Nursing, Faculty of Nursing, Assiut University, and one lecturer of internal medicine, Faculty of Medicine, Assiut University who assessed the tools for clarity, relevance, comprehensiveness, understanding, applicability, and easiness.

#### **Reliability:**

Cornbach's alpha is the most widely used method for evaluating internal consistency of the research tools. It can be interpreted like other reliability coefficients. The normal range of value is between 0.00 and 1.00, and higher values reflect a higher internal consistency. The reliability of the study tools was (0.967, 0.824).

#### **Pilot Study:**

It was conducted on 10 patients to evaluate the clarity, feasibility, and applicability of the tools. Omission and addition were completed according to pilot results. Patients participated in the pilot study were excluded from the main study and replaced by another.

**Field work phase:**

- Data collection had been passed by three consecutive processes: assessment, implementation, and evaluation.

**Assessment**

- Data collection started in May 2022 and ended in November 2022.
- All patients recruited to the center either from center attendee (new and established) or referred patients from the internal medicine ward. The assigned days for patients' recruitment were three day/week. The started time for data collection was 9:00 a.m. The researchers planned the first hour and half of the day for completing base line assessment.
- The current assigned physician referred potential patients to the researchers who were available in the teaching room inside the center.
- At the beginning; the researchers introduced self and initiated line of communications, explained that they might experience minor discomfort in their feet while doing CNE "pin prick.
- According to patients' desire, researchers grouped patients into male or female groups.
- Each patient either male or female had been assessed individually twice; first at base line then after three months duration. Tool (I & II) had been completed by nursing researchers while tool III had been completed by medical researcher.
- Demographic data had been assessed once at base line using part 1(tool I).
- Clinical data had been assessed once at base line using part2 (tool I).
- Self-care practices had been assessed twice (base line -follow up) using part 3 (tool I)
- Lab. investigations had been assessed twice (base line -follow up) using part 4 (tool I); According to blood sugar level; most patients came to the center after they were having their breakfast. Thus, fasting blood glucose can't be assessed. It was recommended that assessing postprandial blood glucose level is enough.
- Knowledge about diabetes self-care had been assessed twice (base line -follow up) using tool II.
- The stage & severity of DPN had been assessed twice (base line -follow up) using tool III CNE scale.

**Implementation:**

Once assessment had been completed around 10:30 a.m. The nursing researchers started delivering the care bundle in the form of sessions. The care bundle had 6 participants in two groups in each session:

**The first face to face education session:**

**Objectives:** To give patients basic information about diabetic peripheral neuropathy. **Time:** 30 minutes. **Contents:** Inform patients about the purpose of the care bundle; rapport building. Educate patients on

basic disease information; Encourage patients to ask questions and confirm patients understand what they were told. **Teaching method/media:** Lecture, small group discussion/ illustrated pictures. **By the end;** a summary was made and time allowed for questions and answers& plan for next session was made.

**2<sup>nd</sup> face to face education session: Objectives:** To empower patients with knowledge and skills about the importance of glycemic control and consequences of uncontrolled blood glucose. **Time:** 60 minutes **Contents:** Help patients comprehend and understand the relation between glycemic control and maintenance on the stage of diabetic peripheral neuropathy. Educate patients on measures of glycemic control as making healthy food choices, physical activity, stress management, self-monitoring, adherence to medication, demonstrate the correct site for insulin injection; stress on the importance of rotation of the insulin injection site to avoid complication. Pay attention to signs and symptoms of uncontrolled (Hypo- hyper) blood sugar. and regular follow-up. **Teaching method/media:** Lecture, small group discussion, demonstration and re-demonstration/ illustrated pictures, recorded videos on mobile screen, and printed hand out. **By the end;** a summary was made and time allowed for questions and answers& plan for next session was made.

**3<sup>rd</sup> face to face education session: Objectives:** To empower patients with knowledge and skills about foot care. **Time:** 60 minutes **Contents:** (1) instruct patients to inspect their feet and the inside of shoes daily, wash feet daily (with careful drying, particularly between toes), avoid using chemical agents or plasters to remove calluses or corns, avoid cutting calluses or blisters without supervision, use emollients to lubricate dry skin, and cut toe nails straight across; (2) instruct patients to use socks without elastic and sewing; (3) instruct patients to avoid walking barefoot or wearing shoes without socks or slippers and to seek medical assistance whenever identifying problems in their feet; and (4) encourage the patient to adhere to this foot-care advice. **Teaching method/media:** small group discussion/ illustrated pictures, recorded videos on mobile screen, and printed hand out. **By the end;** a summary was made and time allowed for questions and answers& plan for next session was made.

**Monthly follow-up phone calls: Objectives:** To provide feedback and suggestions according to patients' comeback. **Time:** 30 minutes **Content:** Ask and emphasize the compliance with all bundle elements through self-management strategy that should be followed by participants to maintain the achieved results after providing a care bundle. Conclude what is discussed and encourage patients to contact healthcare providers when they have health

problems. **Teaching method/media:** Interactive conversation, active listening/audio phone media.

#### Evaluation phase:

After three months, every patient returned in a given appointment for follow up. At this time; each patient had been reassessed for self-care practices, lab. investigation such as HgbA1c and post prandial blood glucose using part 3 and 4 (tool I), DPN related knowledge using tool II, and severity of DPN using CNE (tool III).

#### Ethics consideration:

Permission to conduct the study was approved from the ethical committee of the Faculty of Nursing and from the hospital authorities of internal medicine and Outpatient of Assiut University Hospital. Prior to the initial interview, the researcher introduced the research to patients who met the inclusion criteria. The researcher emphasized that participation in the study is entirely voluntary; anonymity and confidentiality were assured through coding the data.

The patients had the right to refuse to participate in the study and can withdraw at any time. All research ethics principles had been fulfilled according to the **World Medical Association Declaration of Helsinki, (1997).**

#### Statistical Design:

Data were analyzed with the Statistical Package for Social Sciences (SPSS) version 22. Continuous variables were expressed as mean  $\pm$  standard deviation. Categorical variables were expressed as frequency and percentage. The chi-square test for association was used to determine if there was a relationship between two categorical variables. The independent *t*-test was used for comparing the mean of parametric variables. the chi-square test was used for categorical data. A correlation coefficient "Pearson correlation" is a numerical measure of some type of correlation, meaning a statistical relationship between two variables. the level of statistical significance was set at  $P < 0.05$

#### Results:

**Table (1): Distribution of studied patients according to their demographic characteristics (n=62).**

Demographic characteristics	N	%
<b>Age:</b>		
20 - <35	8	12.9
35 - <50	16	25.8
50 – 65	38	61.3
<b>Mean (SD)</b>	<b>50.29(6.87)</b>	
<b>Gender:</b>		
Male	19	30.6
Female	43	69.4
<b>Residence:</b>		
Rural	17	27.4
Urban	45	72.6
<b>Marital status:</b>		
Single	14	22.6
Married	48	77.4
<b>Level of education:</b>		
Non educated	32	51.6
Educated	30	48.4
<b>Occupation:</b>		
Work	6	9.7
Not-work	56	90.3

Table (2): Distribution of studied patients according to their clinical data (n=62).

Clinical data	N	%
<b>Weight:</b>		
Mean SD	77.29(14.06)	
<b>Height:</b>		
Mean SD	157.12(26.04)	
<b>BMI:</b>		
Normal	38	61.3
Overweight	18	29
Obese	6	9.7
<b>Diabetes experience:</b>		
New	3	4.8
Old	59	95.2
<b>Type of diabetes:</b>		
Type I	9	14.5
Type II	53	85.5
<b>Duration of DM:</b>		
0 - <7	15	24.2
7 - <14	27	43.5
14 - <21	15	24.2
21 - 28	5	8.1
Mean SD	11.45(2.98)	
<b>Diabetes treatment:</b>		
Oral	31	50
Insulin	18	29
Mixed	13	21
<b>Co-morbid condition:</b>	15	24.2
Hypertension		
<b>Associated medical condition*</b>		
Retinopathy	6	9.7
Nephropathy	7	11.3
<b>Received information about diabetes self-care</b>		
Yes	36	58.1
No	26	41.9

Table (3): Comparison between studied patients according to their self-care practices at baseline and follow-up (n=62).

Self-care practices	Baseline		Follow-up		T -Test P- value
	N	%	N	%	
<b>Diet:</b>					
No special diet	6	9.6	48	77.4	12.865
Balanced Diabetic	56	90.4	14	22.6	<0.01**
<b>Exercise (physical activity):</b>					
Sedentary lifestyle	13	20.9	0	0	11.333
No exercise but active	43	69.4	31	50	<0.01**
30 minutes or more of exercise	6	9.7	31	50	
<b>Blood glucose self-monitoring</b>					
Daily or more than twice a week	1	1.6	1	1.6	8.220
Twice or thrice a month	19	30.6	24	38.7	<0.01**
Once a month or once in two months	20	32.3	37	59.8	
Never	22	35.5	0	0	

\*\* highly statistically significant P value < 0.01

**Table (4): Comparison between studied patients according to their neuropathy stage, severity, and lab investigations at baseline and follow-up (n=62).**

Neuropathy stage & severity	Baseline		Follow-up		Chi-square P- value
	N	%	N	%	
<b>Neuropathy stage:</b>					
Stage zero/one	0	0	0	0	-----
Stage two	58	93.5	58	93.5	
Stage three	4	6.5	4	6.5	
<b>Severity</b>					
Id (1-9)	55	88.7	57	91.9	3.287 <0.05*
oderate (10: 18)	5	8.1	4	6.5	
vere (19: 33)	2	3.2	1	1.6	
<b>Laboratory investigations</b>	<b>Base line data</b>		<b>Follow up</b>		<b>T- test / P -value</b>
<b>HgbA1c (%) value (mmol/L)</b>					
<b>Mean SD</b>	10.56(2.83)		8.83(1.75)		7.669 / <0.01**
<b>Blood Sugar</b>					
<b>Mean SD</b>	235.6(34.90)		149.67(23.19)		12.438 / <0.01**

\* Statistically significant P value &lt; 0.01

\*\* highly statistically significant P value &lt; 0.01

**Table (5): Diabetic Self-Care Knowledge at baseline and follow-up (n=62).**

Diabetic Self-Care Knowledge 30 Q	Baseline	Follow-up	T - test P value
	Mean (SD)	Mean (SD)	
<b>Modifiable Lifestyles (1-18Q)</b>	7.30(2.24)	13.14(3.67)	12.065 <0.01**
<b>Knowledge of Adherence to Diabetes Self-Care (19-26Q)</b>	1.95(0.47)	5.25(1.04)	10.334 <0.01**
<b>Consequences of Uncontrolled Blood Sugar (27-30Q)</b>	1.17 (0.26)	2.53(0.63)	8.142 <0.01**
<b>Total Diabetic Self-Care Knowledge 30 Q</b>	10.43 (3.71)	20.93(4.76)	14.523 <0.01**

\*\* highly statistically significant P value &lt; 0.01

**Table (6): Correlation between studied variables (follow-up at three months)**

Variables		Severity of neuropathy	HgbA1c
<b>Total Diabetic Self-Care Knowledge 30 Q</b>	R	-0.342	-0.301
	p	<0.05*	<0.05*
<b>Exercise (physical activity)</b>	R	-0.375	-0.415
	p	<0.05*	<0.05*
<b>Diet</b>	R	-0.369	-0.422
	p	<0.05*	<0.05*
<b>Blood glucose self-monitoring</b>	R	- 0.299	- 0.267
	p	<0.05*	<0.05*

\* Statistically significant P value &lt; 0.01

As shown in **table (1)**: This study is conducted on 62 patients. Regarding their characteristics, less than two thirds of them (61.3%) are between 50 to 65 years old with mean (S.D) 50.29 (6.87) years. Concerning gender, more than two thirds of them (69.4%) are females. As regard their residence, nearly three quarters of them (72.6%) are from urban. More than three quarters of them (77.4%) are married. More than

half of them (51.6%) are Illiterate. Regarding occupation, almost half of them (48.4%) are housewives.

**Table (2)**: Illustrates clinical data of the studied patients. Regarding their weight, almost half of them (48.4%) are 70 to less than 90 kg with mean 77.29 (14.06) kg. Concerning their height, more than half of them (53.2%) are 150 to less than 165 cm. with mean 157.12 (26.04) cm. As



regard BMI, less than two thirds of them (61.3%) are normal. The majority of them (95.2%) have old diabetes experience. Most of them (85.5%) have type two diabetes. Less than half of them (43.5%) have diabetes from 7 to less than 14 years ago. Half of them (50%) take oral hypoglycemic drugs. Almost two thirds of them (64.5%) haven't associated medical condition, while nearly one quarter of them (24.2%) have hypertension. More than half of them (58.1%) received information about diabetes self-care. Most of them (88.7%) didn't have glucometer.

**Table (3):** Correlates between the health history of the studied patients at baseline and follow-up. It shows that there is a marked improvement in the patient's diet with a highly statistically significant difference ( $P<0.01$ ) between baseline and follow-up phases. As evidence, the minority of them (9.6.8%) have balanced diet at baseline phase, while more than three quarters of them (77.4%) have at follow-up phase.

Also, **table (3):** Shows a marked improvement in exercise (**physical activity**) with a highly statistically significant difference ( $P<0.01$ ) between baseline and follow-up phases. As evidence, more than two thirds of them (69.4%) don't do exercise but active at baseline phase, whilst half of them (50%) do at follow-up phase. As regard blood glucose monitoring, there is a marked improvement with a highly statistically significant difference ( $P<0.01$ ) between baseline and follow-up phases. As evidence, almost one third of them (32.3%) do it once a month or once in two months at baseline phase, but more than half of them (59.8%) do it at follow-up phase.

**Table (4):** Compares between studied patients according to their neuropathy stage and severity at baseline and follow-up. It portrays that there is an improvement in the patient's level of severity with a statistically significant difference ( $P<0.05$ ) between baseline and follow-up phases. As evidence, most of them (88.7%) have mild level neuropathy at baseline phase, while the majority of them (91.9%) have at follow-up phase. Moreover, there is no statistically significant difference between baseline and follow-up phases as regards neuropathy stage. According to lab investigation at baseline and follow-up. It reveals that there is a marked improvement in the patient's laboratory investigations with a highly statistically significant difference ( $P<0.01$ ) between baseline and follow-up phases. As evidence, HgbA1c level was 10.56(2.83) at baseline phase, while it

was 8.83(1.75) at follow-up phase. Also, Blood Sugar was 235.6(34.90) at baseline phase, while it was 149.67(23.19) at follow-up phase.

**Table (5):** Compares between studied patients according to their diabetic self-care knowledge at baseline and follow-up. It shows that there is a marked improvement in the patient's diabetic self-care knowledge with a statistically significant difference ( $p<0.01$ ) between baseline and follow-up phases as regards all domains listed. As evidence, the mean of modifiable lifestyles is 7.30(2.24) at baseline phase, but it is 13.14(3.67) at follow-up phase. In addition, the mean of total diabetic self-care knowledge is 10.43 (3.71) at baseline phase, whilst it is 20.93(4.76) at follow-up phases.

**Table (6):** Declares that there is a statistically significant negative correlation between the studied patient's total knowledge, severity of neuropathy and level of HgbA1c. Also, a statistically significant negative correlation is found between the studied patient's exercise, severity of neuropathy and level of HgbA1c. As well, there is a statistically significant negative correlation between the studied patient's diet, severity of neuropathy and level of HgbA1c. As well as a statistically significant negative correlation exists between the studied patient's blood glucose monitoring, severity of neuropathy and level of HgbA1c with ( $p< 0.05$ ).

### Discussion:

The study findings showed that the mean age of participant was 50.29(6.87) yrs. This indicated that the older adult age group was the most predominant. This could be explained by DPN is a chronic microvascular complication of diabetes which means that diabetic patients either type I or type II may develop it later on. On the other hand, the majority of studied patients had type II diabetes which has a late onset of age. Furthermore stage 0/1 DPN is asymptomatic so many patients come late and they didn't know that they had. In accordance a recent study conducted by **Helmy et al., (2022)** the mean age of their participants was around fifty too. Nearly to this study finding another study by **Mohammed et al., (2018)** which reported that the mean age of their participants was around fifty too.

Regarding gender; It was found out that females more than males this could be interpreted by females tend to search for medical services more than men this is sometimes as a given that men usually have a lowest percent. Relatively the low male percent may be due to that they can't bear waiting for long time or routine work in governate setting thus they may go for private settings. Conversely **Farias et al., (2023)** in

their observational cross-sectional study reported that men had a higher incidence of DPN (more than half) compared to women (less than half). The difference may be influenced by the characteristics of each location/region.

Regarding diabetes duration, results demonstrated that the mean duration of diabetes was 11.45(2.98) years. In the same line **Abosrea et al., (2020)** reported that the mean duration of diabetes in males was 10.11±8.23 years and 6.81±5.99 years in females. Given that duration of diabetes it considers a non-modifiable risk factors which must be put in consideration when treating patient with DPN particularly when targeting a maintenance, the stage & severity of DPN. Two studies by **Awadalla et al., (2017) & Pan, (2018)**. Both of them found a significant association between longer duration of diabetes (more than ten years) and DPN in diabetic patients.

In relation to associated medical condition nearly one quarter of studied patients had hypertension and about ten percent of studied patients had retinopathy and nephropathy. This is consistent with **Kisozi et al., (2017)** who found a significant association between peripheral neuropathy and some variables such as hypertension, older age, nephropathy, and retinopathy. According to researchers; high blood glucose levels can cause widespread damage to tissues and organs, including those that play a key role in maintaining healthy blood pressure. For example, damage to the blood vessels and kidneys can cause blood pressure to rise.

Although the study results showed that more than half of participant had received information about diabetes self-care but their total mean score knowledge as measured by DSCK scale was deficient at base line assessment. Relatively this could be explained by the higher percentage of illiterate participants as shown in demographic data. Similar finding in a study by **Zerihun et al., (2021)** who reported that the magnitude of diabetes self-care knowledge wasn't adequate and some critical knowledge gaps were identified.

Conversely a cross sectional study by **Niguse et al., (2019)** found that participant had a good level of knowledge regarding diabetes self-care. **Kisozi et al., (2017)** concluded their study by increased diabetes knowledge and regular blood sugar screenings would play an important role in identifying this problem. While at follow up the total mean score level of knowledge was improved. This finding in accordance with **Helmy et al., (2022)** who found strong positive relationships between all of the total dimensions indicated in terms of peripheral neuropathy nursing educational needs and rationalized the raised awareness about glycemic management, eating a

healthy diet, exercises, and footcare were due to the increased awareness about the disease process.

From the perspective of the researchers; the difference could be attributed to the effect of delivering nursing care bundle in a systematic and bundled approach which switched patients from reactive to proactive as well as it gave them more opportunities for communication, clarification, misunderstanding correction of their self-care practices regarding life style modification, adherence to self-care practices, and orienting them to the consequences of uncontrolled blood sugar. Due to the shortage of available studies on nursing care bundle and its effect on DPN. Makes it difficult to compare our results with other studies and thus enhance our understanding of the intervention effect.

To assess DPN severity A CNE scale was used at base line assessment then reused after three months follow up. The highest percentage was for mild DPN in both times (88.7%, 91, 9%) respectively. In the same line **Dinh et al., (2022)** found the highest percentage of DPN severity was for mild DPN too. Moreover, the results showed a marked improvement in the patients' level of DPN severity at follow up than base line assessment. Also, all patients still in the same disease stage and not progress to the next stage. This agree with the fact that DPN is an irreversible disease so maintaining on patients' condition to be controlled and not go away to possible complications is more essential. Similar to the study findings **Ahrary et al. (2020)** conducted a supportive educational intervention reported that after intervention the severity of neuropathy significantly decreased in the trial group compared with control group.

Regarding lab investigations; the study findings revealed a marked improvement in patients' HgbA1c and postprandial blood glucose with a highly statistically significant difference between base line and follow up phases. In the same line A randomized controlled trial by **Al-Lenjawi et al., (2017)** Findings indicated statistically significant improvement in the intervention group, especially in HgbA1c reduction. Previous study by **Abd-El salam et al., (2023)** highlighted uncontrolled blood glucose is one of significant risk factors for diabetic foot ulcer which is a common consequence of DPN. This is complied with **Qureshi, et al. (2017) & Dinh et al., (2022)** who founded the severity of diabetic neuropathy was higher in older patients, those with greater duration of diabetes, high HgbA1c, with micro and macrovascular complications.

Regarding self-care practices; it was found that minor percent of participant (9.6.8%) have balanced diet at baseline phase, while more than three quarters of them (77.4%) have at follow-up phase. According to

researchers, the positive change concerning diet from no specific diet to balanced diet could be due to the participant followed instructions pertaining diet in the second bundle element which adopted a healthy diet approach for maintaining blood glucose; one contains all nutritional elements with reduction of table sugar, carbohydrates, and fats especially saturated fats also. It was adopted this evidence by **Pollakova et al., (2021)** who discovered the incidence of diabetes is low in vegetarians. So profuse fruits and vegetables was recommended too.

Concerning exercise, there was a marked improvement with a highly statistically significant difference between baseline and follow-up phases. As evidence, at baseline; more than two thirds of them don't do exercise but active "patients described that they do the house work and didn't practice exercise on a regular basis", whilst half of them do at follow-up phase. **Diabetes Prevention Program Research Group, (2015)** emphasized on the regulation of blood glucose can be achieved through diet, exercise, and medication, all work together. In a large randomized controlled trial established by **Sigal et al., (2007)** reported that aerobic exercise improves physical fitness, glycemic control, and insulin sensitivity in people with diabetes. Therefore, exercise is recommended as a way for people with diabetes to improve glycemic control and minimize diabetic complications. Other studies by, **Iunes, (2014); Fayed, (2016); Kanchanasamut; & Kluding, (2017)** arrived at evidence that improvements in DPN symptoms, joint ROM, as well as improvement in musculoskeletal condition can be achieved with specific foot ankle exercises

### Conclusion:

This study confirmed the supposed hypotheses; diabetic patients maintained their DPN stage and didn't progress to the next stage. Also, the severity of symptoms had been decreased in some patients with a given nursing care bundle.

### Recommendation:

A nursing care bundle should be delivered for patients with diabetic peripheral neuropathy and should be an integral part of diabetes care.

### References:

- **Abosrea M. Ali, Elmasry H. Anwa, & Oraby M. Ibrahim, (2020):** Gender differences in Diabetic Peripheral Neuropathy, *Vol.(1), No. (1)*, Pp. 55-64. DOI: [10.21608/ejmr.2020.89059](https://doi.org/10.21608/ejmr.2020.89059)
- **Adibe MO, Aguwa CN, & Ukwe CV, (2011):** The construct validity of an instrument for measuring type 2 diabetes self-care knowledge in Nigeria. *Trop J Pharm Res.* 2011; 10(5):619–629.
- **Ahrary Z, Khosravan S, Alami A, & Najafi Nesheli M., (2020):** The effects of a supportive-educational intervention on women with type 2 diabetes and diabetic peripheral neuropathy: a randomized controlled trial. *Clinical Rehabilitation.* Vol. 34 No. (6): Pp. 794-802. doi:[10.1177/0269215520914067](https://doi.org/10.1177/0269215520914067)
- **Al-Lenjawi B., Mohamed H., Amuna P., Zotor F., & Ziki M. (2017):** Nurse-led theory-based educational intervention improves glycemic and metabolic parameters in south asian patients with type II diabetes: A randomized controlled trial. *Diabetology International, Vol. 8 No. (1), Pp. 95-103.* doi:[10.1007/s13340-016-0286-](https://doi.org/10.1007/s13340-016-0286-)
- **Amara F., Hafez S., Orabi A., El Etriby A., Abdel Rahim A., Zakaria A., Koura F., Talaat F. M., Gawish H., Attia I., Abdel Aziz M., El Hefnawy M., Kamar M., Halawa M.R., El-Sayed M., El Kafrawy N., Khalil S. & Assaad S. (2019):** Review of diabetic polyneuropathy: pathogenesis, diagnosis and management according to the consensus of Egyptian experts. *Current Diabetes Reviews, Vol. (15), No. (4): Pp. 340-345.*
- **American Diabetes Association Professional Practice Committee; (2022):** Retinopathy, Neuropathy, and Foot Care: Standards of Medical Care in Diabetes—2022. *Diabetes Care, S185–S194.* <https://doi.org/10.2337/dc22-S012>
- **Assiut University Hospital record, (2021):** Assiut hospital statistics, Assiut University, Egypt.
- **Awadalla H, Noor SK, Elmadhoun WM, Almobarak AO, Elmak NE, Abdelaziz SI, Sulaiman AA, & Ahmed MH., (2017):** Diabetes complications in Sudanese individuals with type 2 diabetes: Overlooked problems in sub-Saharan Africa? : S1047-S1051. doi: [10.1016/j.dsx.2017.07.039](https://doi.org/10.1016/j.dsx.2017.07.039). PMID: 28789834.
- **Bairaktaridou A., Lytras D., Kottaras I., Iakovidis P., Kottaras A, & Chasapis G. (2021):** The role of electrotherapy in the treatment of symptoms of diabetic peripheral neuropathy. *Ortho research journal, Vol. (5), No. (2): Pp. 27-29.* <https://doi.org/10.33545/orthor.2021.v5.i2a.279>.
- **Bondor CI, Veresiu IA, Florea B, Vinik EJ, Vinik AI, Gavan NA. Epidemiology of Diabetic Foot Ulcers & Amputations in Romania, (2019):** Results of a Cross-Sectional Quality of Life

- Questionnaire Based Survey. Journal of Diabetes Research; 2016: e5439521. pmid:27019852
- **Boulton A., Gries F. & Jervell J. (1998):** Guidelines for the diagnosis and outpatient management of diabetic peripheral neuropathy. Diabetes Medicine, Vol. (15), No. (6), P. 508.
  - **Bus SA, van Netten JJ, Lavery LA, Monteiro-Soares M, Rasmussen A, Jubiz Y, Price PE; International Working Group on the Diabetic Foot. IWGDF, (2016):** guidance on the prevention of foot ulcers in at-risk patients with diabetes. doi: 10.1002/dmrr.2696. PMID: 26334001.
  - **Diabetes Prevention Program Research Group, (2015):** Long-term effects of lifestyle intervention or metformin on diabetes development and microvascular complications over 15-year follow-up: the Diabetes Prevention Program Outcomes Study. Lancet Diabetes Endocrinol; Vol. (3), No. (11): Pp. 866-75. doi: 10.1016/S2213-8587(15)00291-0. PMID: 26377054; PMCID: PMC4623946.
  - **Dinh Le T, Phi Thi Nguyen N, Thanh Thi Tran H, Luong Cong T, Ho Thi Nguyen L, Do Nhu B, Tien Nguyen S, Van Ngo M, Trung Dinh H, Thi Nguyen H, Trung Nguyen K, Le DC. (2022):** Diabetic Peripheral Neuropathy Associated with Cardiovascular Risk Factors and Glucagon-Like Peptide-1 Concentrations Among Newly Diagnosed Patients with Type 2 Diabetes Mellitus; 15: 35-44. doi: 10.2147/DMSO.S344532. PMID: 35023938; PMCID: PMC8747623.
  - **Farias A.L.d.; Silva A.S.A.d.; Tavares V.B.; Souza J.d.S.e.; Silva H.P.d.; Oliveira Bastos M.d.S.C.-B.d.; Melo-Neto, J.S.d. & Amazon Amandaba, (2023):** Prevalence, Risk Factors and Self-Care Perception Associated with Diabetic Peripheral Neuropathy in Patients with Type 2 Diabetes: A Cross-Sectional Study. Healthcare 2023, 11, 518. <https://doi.org/10.3390/healthcare11040518>
  - **Fayed EE, Mohamed Badr N, Mahmoud S, & Hakim SA., (2016):** Exercise therapy improves planter pressure distribution in patients with diabetic peripheral neuropathy. Int J PharmTech Res. Vol. (9) No. (5): Pp. 151–9.
  - **Gilroy A., Macpherson. B., Wikenheiser J., Schuenke M., Schulte E, & Schumacher U. (2020):** Atlas of anatomy.4<sup>th</sup> Ed. New York. Pp. 472-486.
  - **Helmy N. Mohamed, Aly A. Anwar, Awad W. Hassan, Younes M. Mohamed, & Almanzlawi H. Ali (2022):** Effect of Coaching Program on Prevention of Peripheral Neuropathy Deterioration among Patients with diabetes mellitus, Egyptian Journal of HealthCare, 2022 EJHC Vol.(13) .No.(3) Pp. 1661- 1674
  - **Iunes DH, Rocha CBJ, Borges NCS, Marcon CO, Pereira VM, & Carvalho LC., (2014):** Selfcare associated with home exercises in patients with type 2 diabetes mellitus. PLOS. ; Vol. (9) No. (12) P.114151.
  - **Kanchanasamut W. (2017):** Effects of weight-bearing exercise on a minitrampoline on foot mobility, plantar pressure and sensation of diabetic neuropathic feet; a preliminary study. Diabetic Foot Ankle. Vol.8No. (1):1287239.
  - **Kassar, A., & Khudur, M. (2021):** Evaluation of nurses' practices regards diabetic foot care management at teaching hospitals in al- Nasiriya city. Kufa journal for nursing sciences, Vol. (11), No. (1): Pp.12500-12506.
  - **Kioskli K, Scott W, Winkley K, Kylakos S, & McCracken LM.,(2019):** Psychosocial Factors in Painful Diabetic Neuropathy: A Systematic Review of Treatment Trials and Survey Studies. Pain Medicine Pp. 1756–73. pmid:30980660
  - **Kisozi T, Mutebi E, Kisekka M, Lhatoo S, Sajatovic M, Kaddumukasa M, Nakwagala FN, & Katabira E. (2017):** Prevalence, severity and factors associated with peripheral neuropathy among newly diagnosed diabetic patients attending Mulago hospital: a cross-sectional study, Vol. 17No. (2): Pp. 463-473. <https://dx.doi.org/10.4314/ahs.v17i2.21>
  - **Kluding PM, Bareiss SK, Hastings M, Marcus RL, Sinacore DR, & Mueller MJ. (2017):** Physical Training and Activity in People with Diabetic Peripheral Neuropathy. Vol. (97) No. (1): Pp. 31-43. doi: 10.2522/ptj.20160124. PMID: 27445060; PMCID: PMC6256941.
  - **Lavallée JF, Gray TA, Dumville J, Russell W, & Cullum N. (2017):** The effects of care bundles on patient outcomes: a systematic review and meta-analysis. Vol. (12) No. (1), p.142. doi: 10.1186/s13012-017-0670-0. PMID: 29187217; PMCID: PMC5707820.
  - **Mohmed F. Gomaa, ElGuindi F. Khyrat, & Esmat O. Mohmed, (2018):** Home Care for Clients with Diabetic Peripheral Neuropathy, Egyptian Journal of Health Care, Vol. (19).No.(4) Pp. 513-535
  - **Niguse, H., Belay, G., & Fisseha, G. (2019):** Self-care related knowledge, attitude, practice and associated factors among patients with diabetes in Ayder Comprehensive Specialized Hospital, North Ethiopia. BMC Res Notes Vol. (12), No.(34), <https://doi.org/10.1186/s13104-019-4072-z>
  - **Papanas N, (2019): Prediabetic neuropathy: does it exist?** Vol. (12) Pp. 376–83. <https://doi.org/10.1007/s11892-012-0278-3>

- **Pollakova D, Andreadi A, Pacifici F, Della-Morte D, Lauro D, & Tubili C., (2021):** The Impact of Vegan Diet in the Prevention and Treatment of Type 2 Diabetes: A Systematic Review. *Nutrients*. Vol. (13), No. (6): P. 2123. doi: 10.3390/nu13062123. PMID: 34205679; PMCID: PMC8235036.
- **Pop-Busui R, Boulton AJ, Feldman EL, Bril V, Freeman R, & Malik RA, (2017):** Diabetic Neuropathy: A Position Statement by the American Diabetes Association. *Diabetes Care*, Vol. (40) No. (1): Pp. 136–154. 10.2337/dc16-2042.
- **Qureshi, M., Iqbal, M., Zahoor, S., Ali, J., & Javed, M. (2017):** Ambulatory screening of diabetic neuropathy and predictors of its severity in outpatient settings. *Journal of endocrinological investigation*, Vol. (40), No. (4), Pp. 425-430
- **Rosner B. (2011):** *Fundamentals of Biostatistics*. 7th ed. Boston, MA: Brooks/Cole; Kane SP. Sample Size Calculator. ClinCalc: <https://clincalc.com/stats/SampleSize.aspx>. Updated July 24, 2019. Accessed September 18, 2020.
- **Sallam, A., & Edison, S. (2019):** Effect of nursing instructions on diabetic patients' knowledge about peripheral neuropathy and foot care. *American Journal of Nursing Research*, Vol. (7), No (4): Pp. 626-632, DOI: 10.12691. <http://pubs.sciepub.com/ajnr/7/4/23>
- **Saltar, L, & Sahar, J, (2020):** Effects of physical exercises on peripheral neuropathy sensation in patients with type 2. *Asian Community Health Nurses Research*, Vol. (2), No (2): Pp. 11–21. <http://journal.jptranstech.or.id/index.php/ACHNR>
- **Sigal J Ronald, Glen P Kenny, Normand G Boulé, George A Wells, Denis Prud'homme, Michelle Fortier, Robert D Reid, Heather Tulloch, Douglas Coyle, Penny Phillips, Alison Jennings, James Jaffey (2007):** Effect of aerobic training, resistance training, or both on glycemic control in type 2 diabetes: a randomized trial *Ann Intern Med*. Vol. (147) No. (6): Pp. 357-69. doi: 10.7326/0003-4819-147-6-200709180-00005.
- **Valk GD, Nauta JJP, Strijers RLM, & Bertelsman FW, (1992):** Clinical examination versus neurophysiological examination in the diagnosis of diabetic polyneuropathy. Vol. 9, Pp. 716–721
- **World Medical Association declaration of Helsinki., (1997):** Recommendations guiding physicians in biomedical research involving human subjects. *JAMA*, Vol. (277) No. (11): Pp. 925-6. PMID: 9062334.
- **Zerihun Sahile L., Shifraew M. Benayew, & Zerihun Sahile M. (2021):** Diabetic Self-Care Knowledge and Associated Factors Among Adult Diabetes Mellitus Patients on Follow-Up Care at North Shewa Zone Government Hospitals, Oromia Region, Ethiopia, 2020, *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy*, Vol. (14) Pp. 2111–2119, available at <https://doi.org/10.2147/DMSO.S298336>
- **Ziegler D., Tesfaye S., Spallone V., Gurieva I., Al Kaabi J., Mankovsky B., Martinka E., Radulian Nguyen K., Stirban A., Tankova T., Varkonyi T., Freeman R., Kempler P, & Boulton J, (2021):** Screening, diagnosis and management of diabetic sensorimotor polyneuropathy in clinical practice: International expert consensus recommendations. *Diabetes Research and Clinical Practice*. Pre proofs journal, Pp.1-2. doi/10.1016/j.diabres.2021.109063.