

## ORIGINAL ARTICLE

# QUALITY OF LIFE IN PATIENTS WITH DIABETIC POLYNEUROPATHY WITH INCREASED PHYSICAL ACTIVITY

DOI: 10.36740/WLek202106102

Tetiana G. Bakaliuk<sup>1</sup>, Nadiya R. Makarchuk<sup>1</sup>, Halina O. Stelmakh<sup>1</sup>, Larysa P. Martynyuk<sup>1</sup>, Yevhen Yu. Strashko<sup>2</sup>, Larysa V. Levytska<sup>1</sup>

<sup>1</sup> I. HORBACHEVSKY TERNOPIŁ NATIONAL MEDICAL UNIVERSITY, MINISTRY OF HEALTH OF UKRAINE, TERNOPIŁ, UKRAINE

<sup>2</sup> POLTAVA STATE MEDICAL UNIVERSITY, POLTAVA, UKRAINE

## ABSTRACT

**The aim:** Is to investigate the impact of comprehensive treatment on diabetic polyneuropathy (DPN) patients' quality of life by including rehabilitation approaches with increased physical activity in standard drug treatment regimens.

**Materials and methods:** 117 patients with type 2 diabetes and DPN were examined. The patients under examination were divided into 4 groups: the control group (group I) included 32 patients who received medicinal (drug) treatment. 12 supplementary daily treatment procedures with polarized light were additionally prescribed to 32 patients of the second experimental group. In addition to drug treatment and polarizing light procedures, 31 patients of group III and 22 patients of group IV were prescribed dosed therapeutic walking 3 times a week №12 (group III) or Nordic walking 3 times a week №12 (group IV).

**Results:** The supplemental use of dosed therapeutic walking and Nordic walking in addition to the protocol treatment regimens contributes to the positive dynamics of quality of life of patients with DPN-complicated type 2 diabetes mellitus, which is confirmed by significant positive dynamics reflected in the following sections of the EQ-5D-3L questionnaire, such as motor (2.3 times,  $p < 0.05$ ), self-care (1.4 times,  $p < 0.05$ ), resumption of normal daily activities (2.9 times  $p < 0.05$ ) reduction of the frequency of discomfort (4.2 times,  $p < 0.05$ ) and anxiety-depressive states (2.7 times,  $p < 0.05$ ).

**Conclusions:** Increased physical activity of patients with DPN significantly affects their life quality and proves to be a clinically effective approach to such patients.

**KEY WORDS:** diabetic polyneuropathy, physical activity, therapeutic dosed walking, Nordic walking

Wiad Lek. 2021;74(6):1302-1306

## INTRODUCTION

The prevalence of diabetes mellitus (DM) in industrialized countries ranges from 5.9% to 8.1% and is growing sharply due to increased obesity and lack of exercise [1]. Current recommendations for the medical treatment of diabetes are primarily focused on accurately measuring and regulating blood sugar levels. In addition, the symptoms associated with diabetic complications should be closely monitored [2].

The functional consequences of DM are complex and multifactorial. An approach that takes into account the interaction between individual attributes and environmental attributes is necessary due to the disabling state of health [3].

One of the most common and intractable complications of DM is diabetic polyneuropathy (DPN) [2]. It is characterized by progressive death of nerve fibers and leads to impairment of vibration, tactile, pain and temperature sensitivity, in particular its distal form [4]. Thus the timely diagnosis of DPN and its correct treatment is of vital importance for patients with diabetes.

However, among people with diabetes and DPN-caused pathology of the lower extremities, the risk due to limited mobility increases almost 3 times compared to those who

have neither. Senior people with diabetes are especially prone to an increased risk of limited mobility [5,6].

Despite significant research data on the benefits of moderate-intensity physical activity (such as brisk walking) for those with diabetes [7,8], another study of the effects of exercise among people with diabetes and DPN was conducted mainly due to exercise concerns among DM patients associated with trauma to participants' insensitive legs and general skepticism that the exercises may be helpful at all. Historically, people with DM and DPN have been advised to avoid physical activity, but inactivity can worsen skin condition and reduce exercise tolerance [9]. Several studies provide evidence to support the hypothesis that less active people with diabetes and DPN are at greater risk of skin damage than those who are more active [9,10].

Increasing evidence suggests that physical activity is a promising therapeutic approach that can improve symptoms and increase the ability to regenerate peripheral nerves [11].

Since the social significance of diabetes is caused not only by the prevalence of the disease, but also the decline in quality of life due to its complications, in particular, the development of DPN, the focus of our study was to assess the quality of life in this group of patients under different rehabilitation approaches.

## THE AIM

Aim of the research is to investigate the impact of comprehensive treatment on diabetic polyneuropathy patients' quality of life by including rehabilitation approaches with increased physical activity in standard drug treatment regimens.

## MATERIALS AND METHODS

117 patients with type 2 diabetes and DPN were examined. The age of the patients examined ranged from 56 to 68 years (mean age  $60.3 \pm 4.3$  years). The duration of diabetes and DPN ranged from 4 to 23 years (average duration  $10.9 \pm 5.7$  years) and from 3 to 13 years (average duration  $5.9 \pm 2.5$  years) respectively. Among those surveyed were 53 (45.3%) men and 64 (54.7%) women.

For the inclusion in the study, the following criteria were to be met: signing of patients' information consent; existence of type 2 diabetes for more than 1 year; confirmed DPN diagnosis, distal symmetrical type, sensory form; age from 45 to 65 years.

Criteria for exclusion from the study were: type 1 diabetes; the presence of acute complications of diabetes; signs of other types of polyneuropathy; patients with vertebro-genic pain syndrome; foot deformity, which requires the manufacture of individual footwear; ulcerative defects of the feet II-IV degree of severity, amputation of the foot or lower extremity; manifestations of severe respiratory failure, with severe heart failure (III - IV FC according to NYHA); patients with unstable angina pectoris, myocardial infarction, transient ischemic attack, and stroke 3 that happened months before inclusion in the study;

All patients received standard DPN therapy according to a unified protocol [12].

The patients under examination were divided into 4 groups: the control group (group I) included 32 patients who received standard treatment according to the unified clinical protocol of primary and secondary (specialized) medical care [12]. 12 supplementary daily treatment procedures with polarized light were additionally prescribed to 32 patients of the second experimental group. In addition to standard treatment and polarizing light procedures, 31 patients of group III and 22 patients of group IV were prescribed dosed therapeutic walking (on a treadmill) 3 times a week №12 (group III) or Nordic walking (NW) 3 times a week №12 (group IV).

A visual inspection of the participant's legs was performed daily. Skin lesions on the lower leg were monitored to confirm the safety of the procedure.

The duration and intensity of workout on the treadmill and the use of NW were selected individually. The target heart rate was to be 60% to 70% of the predicted maximum, and the activity was adjusted to remain within these limits, using a heart rate monitor and estimating the perceived load from 11 to 13 on a scale of 6 to 20 [13,14].

The EQ-5D-3L questionnaire was used to assess quality of life [15,16]. The EuroQol Questionnaire (EQ-5D-3L) is a well-validated, generic tool for assessing quality of life. It

contains 5 sections that assess mobility, self-care, normal activity, pain/discomfort, anxiety/depression. This questionnaire is instrumental not only in assessing the level of quality of life, but also in determining components of its deterioration or improvement, and finding out what needs to be influenced to improve it (provide psychological or social support, adjust treatment, nutrition, lifestyle, etc.) [17,18].

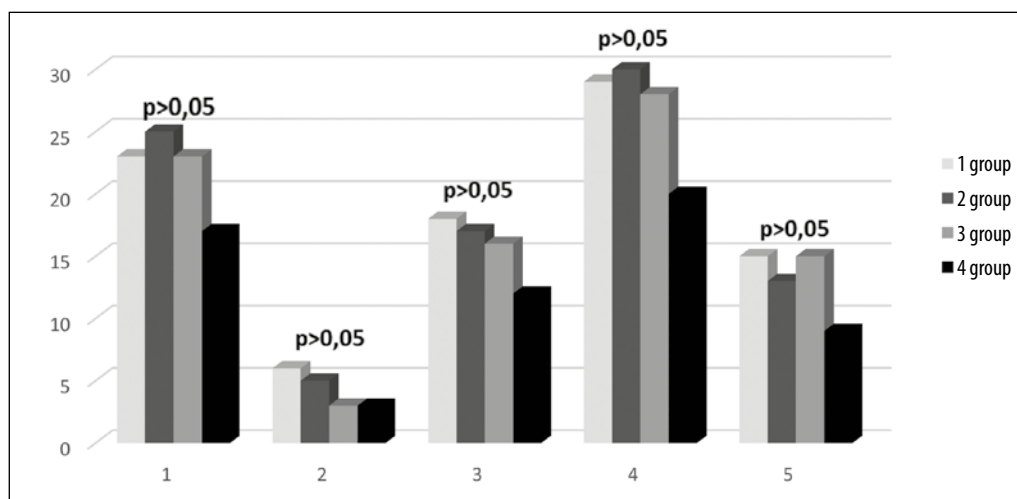
Before filling in this questionnaire, the researcher instructed the patient on how to complete it. For the procedure of filling in the form to be met, the patient filled in the questionnaire, sitting at a table in a quiet room, without being distracted and with no influence from relatives, friends or medical personnel. The patients assessed their condition on the following points: mobility, self-care, daily activity, pain, discomfort, emotional instability (anxiety/depression). The results were evaluated according to the following criteria: no difficulty-1, slight difficulty-2, significant difficulty-3. After completing the questionnaire, the doctor checked the questionnaire for blank areas. The survey was performed three times: on admission, 12 days, and finally 1 month after the start of the diabetic polyneuropathy therapy.

The analysis and processing of clinical trial statistics were performed on a personal computer using STATISTICA 10 and MS Excel XP application packages. Comparisons between groups were performed by comparing the average rank, which was considered reliable at  $p < 0.05$ . Significance of differences between groups was calculated based on the functions of ANOVA-statistics. The difference was considered credible at  $p < 0.05$ .

The research methods used in the test groups of patients with DPN-complicated type 2 diabetes mellitus comply with the requirements of the World Health Association Helsinki Declaration on Ethical Principles for Scientific Research with Human Participation (1964-2000), as was confirmed on the meeting of Bioethics Commission of I.Horbachevsky Ternopil National Medical University of the Ministry of Health of Ukraine of March 15, 2021.

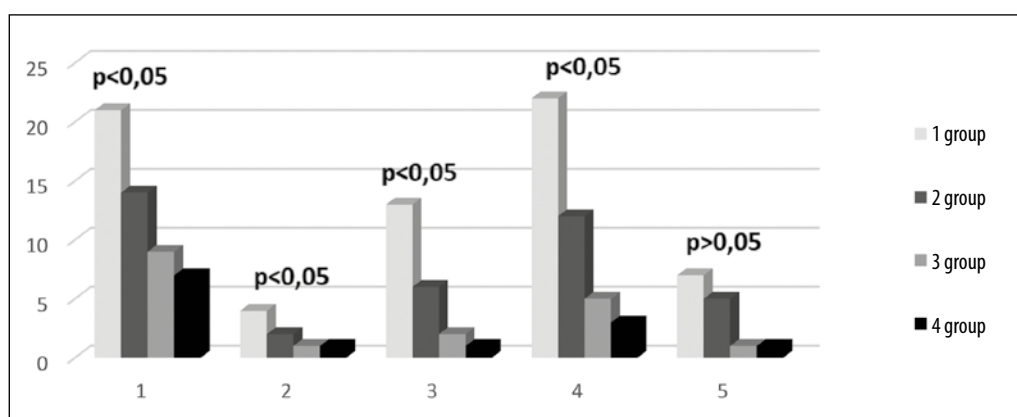
## RESULTS

When analyzing the indicators of quality of life using the EQ-5D-3L questionnaire before treatment, it was found that 29 (24.8%) patients surveyed had no mobility restrictions, whereas minor mobility restrictions occurred in 88 (75.2%) patients. No patient had severe mobility impairment. Self-care was not limited in 100 (85.5%) patients and was moderately limited in 17 (14.5%) respondents. Those who could not take care of themselves at all were not identified among the surveyed. 54 (46.2%) patients could engage in normal daily activities, while 63 (53.8%) had difficulties in performing daily activities. Pain/discomfort was not felt by 7 (6%) respondents, minor discomfort was felt by 97 (82.9%) patients, and severe pain bothered 11 (9.4%) patients. Anxiety/depression did not bother 65 (55.6%) patients with diabetes, 47 (40.2%) felt moderate manifestations, while 5 (4.3%) reported these symptoms



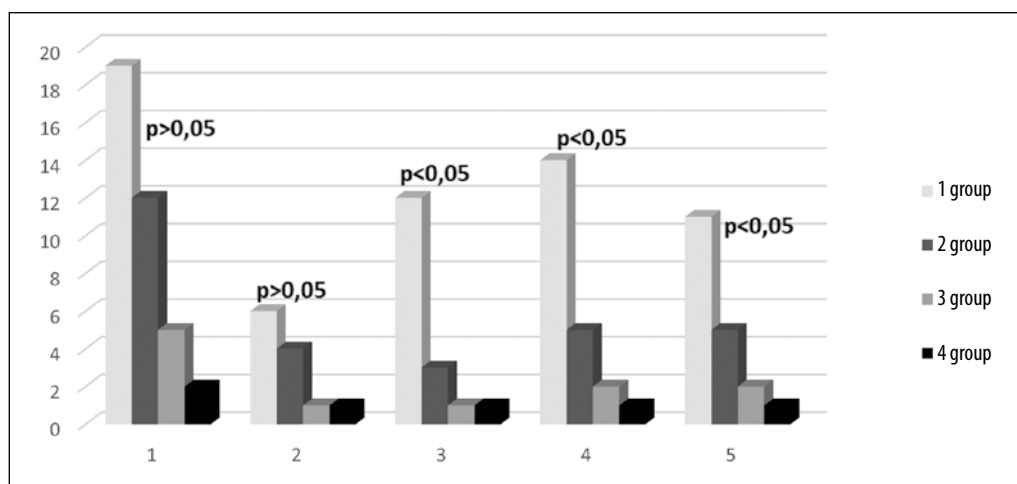
**Fig. 1.** The results of the survey of patients of the test groups (EQ-5D-3L questionnaire) before treatment.

1 - mobility; 2 - self-care; 3 - normal daily activities; 4 - pain/discomfort; 5 - anxiety/depression.



**Fig. 2.** The results of questionnaires of patients in the test groups (EQ-5D-3L questionnaire) 12 days after the start of treatment.

1 - mobility; 2 - self-care; 3 - normal daily activities; 4 - pain/discomfort; 5 - anxiety/depression.



**Fig. 3.** The results of questionnaires of patients in the test groups (EQ-5D-3L questionnaire) 1 month after the start of treatment.

Note: 1-mobility; 2- self-care; 3-normal daily activities; 4- pain/discomfort; 5-anxiety/depression.

as significantly pronounced. The generalized results in the groups according to the EQ-5D-3L questionnaire before treatment are shown in Fig. 1.

Analysis of patients' responses to the questionnaire showed that there were no significant differences in responses among test groups before treatment.

Twelve days after the start of both standard and modified treatment, there was a positive trend in the quality of life of patients, however significantly less discomfort in normal daily activities as well as less pain was reported by patients who were prescribed polarizing light and various kinds of

walking in addition to their standard treatment (Fig. 2).

Quality of life indicator analysis performed 1 month after the start of treatment showed minor limitations of mobility in 19 (59.4%) patients of group 1, 12 (37.5%) patients of group 2, 5 (16.1%) patients of group 3 and 2 (9.1%) patients of group 4. Self-care and normal daily activities were not impaired in 26 (81.3%), 28 (87.5%), 30 (96.8%), 21 (95.5%) and in 20 (62.5%), 29 (90.6%), 30 (96.8%), 21 (95.5%) patients of the 1st, 2nd, 3rd and 4th groups, respectively. After the treatment pain/discomfort was gone in 20 (62.5%), 27 (84.4%), 29 (93.5%) and 21 (95.5%) patients, and anxiety/

depression ceased to bother 21 (65.6%), 27 (84.4%), 29 (93.5%) and 21 (95.5%) patients of the 1st, 2nd, 3rd and 4th groups, respectively.

Normal daily activities, pain/discomfort and anxiety/depression were significantly less disturbing for patients in groups 3 and 4 (Fig. 3), compared with groups 1 and 2 ( $p < 0.05$ ).

Protocol treatment with additional use of polarizing light significantly improved all indicators of the questionnaire 1 month after the start of treatment, whereas supplementary inclusion of dosed therapeutic walk or Nordic walking in the treatment program in addition to polarizing light contributed to a better clinical effect.

## DISCUSSION

DPN causes a decrease in mobility and quality of life due to pain, loss of sensitivity, imbalance, foot ulcers and injuries associated with falls [5,19], so the use of rehabilitation interventions with increased motor activity should prevent such complications.

Assessment of quality of life allows to determine the patient's condition at the moment, is also allows to study the effectiveness of rehabilitation measures and treatment, helps to predict the course of the disease, and shows the patient's inclination both to treatment and the doctor, which can help improve the patient's condition by reducing complications, thus contributing to increased life expectancy [20,21].

Since exercise is a convenient non-medical intervention that is usually recommended for the treatment of metabolic syndrome and type 2 diabetes, we have used 2 types of therapeutic walking to increase physical activity. In our study, we observed a better clinical effect and significant changes in patients' quality of life indicators caused by either NW or therapeutic dosed walking ( $p < 0.05$ ).

Our results are confirmed by other studies, in particular in paper [22] it was shown that NW can be used as a therapeutic exercise in the rehabilitation of various diseases, including diabetes. In addition, aerobic exercise can reduce the risk of complications associated with diabetes.

A study [23] was also conducted to identify the relationship between the quality of life of patients with DPN and their lifestyle changes, in particular increased moderate exercise. Because the development of neuropathy is to some extent associated with impaired microcirculation at the neuronal level, and walking is known to improve blood circulation, the inclusion of therapeutic dosed walking or NW in comprehensive treatment will help reduce pain, restore sensitivity and improve quality of life.

In previous studies [24] we found a positive effect of (polarizing) light therapy procedures on the course of DPN, but these can be carried out only in a medical institution by appropriate personnel, so there are some restrictions on use. Lifestyle changes caused by the introduction of easily performed exercise have proved to be effective, thus significantly changing the life quality indicators in patients who were engaged in NW or therapeutic dosed walking.

In our study, we observed that patients had no difficulty using therapeutic dosed walking, and the presence of sup-

port during Nordic walking reduces impaired coordination and gives confidence to patients, and thus improves their emotional state and quality of life in general. We obtained results showing that both forms of treatment can be well tolerated by patients and improve their quality of life. This is important for such patients, as it will not only prevent complications but also improve the condition of muscle tissue during regular exercise.

Further comparative study of the effectiveness of Nordic walking and therapeutic dosed walking is needed in future.

Therefore, the supplemental use of polarizing light combined with therapeutic dosed walking or Nordic walking in addition to the protocol treatment regimens contributes to the positive dynamics of quality of life of patients and maintaining the clinical effect of increasing exercise in patients with type 2 diabetes mellitus, which is confirmed by significant positive dynamics reflected in the following sections of the EQ-5D-3L questionnaire, such as motor (2.3 times,  $p < 0.05$ ), self-care (1.4 times,  $p < 0.05$ ), resumption of normal daily activities (2.9 times  $p < 0.05$ ) reduction of the frequency of discomfort (4.2 times,  $p < 0.05$ ) and anxiety-depressive states (2.7 times,  $p < 0.05$ ).

Taking into account the clinical condition, both therapeutic dosed walking and Nordic walking programs can last several months. Our results show an improvement in quality of life during one month, but to maintain the desired effect the physical activity should not be reduced.

It is planned to study the longer-term use of these types of physical activity at home without supervision.

## CONCLUSIONS

1. Monitoring the quality of life allows not only to control the functional state of the patients with DPN at different stages of treatment, but also to properly assess the effectiveness of treatment, and if necessary to correct treatment and rehabilitation measures.
2. The use of polarizing light in combination with either therapeutic dosed walking or Nordic walking in addition to standard therapy is likely to have a more positive effect on quality of life compared to protocol medication regimens.
3. Increased physical activity in patients with DPN affects their quality of life and is a clinically effective approach for such patients.
4. To maintain the result for a long time it is necessary to continue to use therapeutic dosed walking or Nordic walking to increase the physical activity of patients with DPN.

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*This study was performed as part of research work of Ternopil National Medical University named after I.Ya. Gorbachev Ministry of Health of Ukraine on «Comorbid conditions in the clinic of internal medicine and family doctor practice: predictors of development, early diagnosis, prevention and treatment» (№ state registration 0113 U001244).*

#### ORCID and contributionship:

Tetiana G. Bakaliuk: 0000-0002-7619-0264 <sup>A</sup>  
 Larysa P. Martynyuk: 0000-0001-8098-0421 <sup>B</sup>  
 Nadiya R. Makarchuk: 0000-0001-5196-1619 <sup>C</sup>  
 Halina O. Stelmakh: 0000-0003-2992-3274 <sup>D</sup>  
 Yevhen Yu. Strashko: 0000-0002-5165-9978 <sup>E</sup>  
 Larysa V. Levytska: 0000-0002-1327-441X <sup>F</sup>

#### Conflict of interest:

*The Authors declare no conflict of interest.*

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#### CORRESPONDING AUTHOR

##### Tetiana G Bakaliuk

I.Horbachevsky Ternopil National Medical University  
 1 Maidan Voli st., 46002 Ternopil, Ukraina  
 tel: +380988364164  
 e-mail: tanita5d@ukr.net

**Received:** 02.11.2020

**Accepted:** 27.04.2021

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**A** - Work concept and design, **B** – Data collection and analysis, **C** – Responsibility for statistical analysis, **D** – Writing the article, **E** – Critical review, **F** – Final approval of the article