

ASSESSMENT OF NURSING AND MIDWIFERY STUDENTS' KNOWLEDGE OF TREATMENT OF DIABETIC FOOT SYNDROME USING LUCILIA SERVICATA LARVAE

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A – study design, B – data collection, C – statistical analysis, D – interpretation of data, E – manuscript preparation, F – literature review, G – sourcing of funding

ABSTRACT

Background: Diabetes mellitus is one of the most common chronic diseases, and in recent years its prevalence has been systematically increasing. Untreated or ineffectively treated diabetes leads to the development of many complications. Among these that can significantly affect the quality of life is diabetic foot syndrome (DFS). Larvotherapy is a therapeutic method of treating wounds arising during the course of DFS.

Aim of the study: The main objective of this study was to assess the level of knowledge of nursing and midwifery students on the treatment of DFS using *Lucilia sericata* larvae.

Material and methods: This study is a cross-sectional, observational study in which 202 nursing and midwifery students of Opole University were surveyed. The study was conducted online between June and November 2020, using a questionnaire developed by the authors.

Results: The analysis showed considerable variation in the level of students' knowledge of treatment techniques for DFS. Those with the highest level of knowledge represented 39.15% (n=79), the average level of knowledge was represented by 28.2% (n=57), and the lowest level of knowledge was represented by 32.7% (n=66) of students. Regarding biosurgery in general, the highest level of knowledge about biosurgery was represented by 48.0% (n=97) of students. Nursing students had a higher level of knowledge than midwifery students regarding DFS treatment methods (p=0.001). There was no difference in the level of knowledge about biosurgery between nursing and midwifery students (p=0.503).

Conclusions: The research presented in this study indicates that nursing and midwifery students have insufficient knowledge of DFS treatment methods and biosurgery. Nursing students are more likely than midwifery students to derive knowledge of DFS treatment methods from their studies and the literature. Education on treatment methods and techniques for DFS should be increased among students. Students' knowledge can be increased by classes in the course of their education and meetings with professionals.

KEYWORDS: diabetic foot syndrome, chronic wounds, biosurgery, *Lucilia sericata* larvae

BACKGROUND

Diabetes is one of the most common chronic diseases, and its prevalence has been systematically increasing in recent years [1]. According to the International Diabetes Federation, 463 million people

were diagnosed with diabetes in 2019. By 2045, it is estimated that this number will increase up to 700 million [2]. Untreated or ineffectively treated diabetes leads to the development of many complications, which are a growing medical challenge. Diabetic foot syndrome (DFS) is one of the common distant com-

plications of diabetes, and warrants special attention due to its high rate of associated amputations and mortality [3]. DFS is defined as infection, ulceration or tissue destruction of the foot associated with neuropathy and/or peripheral arterial disease of the lower extremities in people with diabetes [4,5]. Furthermore, DFS has a long disease course, with the average healing time of ulcers ranging from 2 months to several years [6]. Based on epidemiological studies, it is estimated that 25% of people with diabetes will develop a diabetic foot issue during their lifetime, and between 5% and 15% will be treated for amputation of the foot or leg. Treatment is lengthy and expensive and the outcomes are uncertain [7]. Studies have shown that DFS has been associated with adverse effects that may further impair the quality of life of patients with diabetes and increase the social and economic burden and morbidity [8].

The most important steps in the treatment of DFS include metabolic control of diabetes, which directly translates into improved healing of the damaged skin, antibacterial treatment and foot-pain relief (adjustment of orthotic insoles to the patient's shoes or the use of orthotic shoes). However, in some cases local treatment and surgery are introduced as a therapeutic option. Unconventional methods to treat DFS include vacuum methods, platelet-rich plasma dressings, hyperbaric therapy and larval therapy using the *Lucilia sericata* fly larvae. These methods are effective in promoting healing and reducing infection. When used together with conventional methods of ulcer treatment in DFS, they reduce the risk of amputation [9,10].

Biosurgery, or *Lucilia sericata* larvae therapy, is a natural alternative method used to treat acute and chronic wounds. It involves the pinpoint introduction of sterile flytrap larvae into the patient's wound in a fully controlled process. The larvae, which feed only on necrotic tissue, are carefully selected and come from controlled laboratory environments. They are thawed according to strict rules, under aseptic conditions, on sterile media and their eggs are chemically sterilized [11]. In addition to DFS, larvae are used in the treatment of tissue damage in the course of DFS, bedsores with deep necrosis, congestive venous ulcers, wounds of neoplastic origin, burns, MRSA-infected wounds, post-traumatic wounds not requiring urgent surgical interventions and non-healing wounds following surgery [12]. This method is an effective and safe technique for wound debridement and accelerates the wound healing process, thus resulting in a reduction of treatment costs [13]. Due to the development of multidrug-resistant bacteria, larvae therapy is currently gaining adoption and appreciation [11].

Therapy with *Lucilia sericata* larvae is one form of therapy that can potentially save patients from amputation. Nursing and midwifery graduates play a key role in the therapeutic team and have a signifi-

cant part in shaping other people's attitudes towards the value of health. Therefore, it is important to gain an understanding of the state of knowledge of students on the treatment of DFS using biological material, including *Lucilia sericata* larvae.

AIM OF THE STUDY

The aim of the study was to analyze the level of knowledge of nursing and midwifery students on the treatment of DFS with the use of *Lucilia sericata* larvae.

MATERIAL AND METHODS

Study design and participants

The study was conducted between June and November 2020 using a group of 202 nursing and midwifery students of the Faculty of Health Sciences, University of Opole, Poland. Due to the ongoing SARS-CoV-2 pandemic, the survey was conducted online. The original survey questionnaire was placed on the Google Forms platform, although it was made available to students of selected faculties via the Microsoft Teams web application. Written consent was obtained from the Bioethics Committee at the PMWSZ in Opole (KB: 22/PI/2020). The inclusion criteria for the study were as follows: a student of nursing or midwifery at the University of Opole, and consent to participate in the study (sending the questionnaire). The exclusion criteria were students of cosmetology, physiotherapy, and dietetics at the University of Opole and lack of participant consent. The questionnaire introduction contained information about the aim, method and anonymity of the study, as well as the possibility of withdrawal from the study at any stage.

Data collection

A self-administered questionnaire consisting of 26 questions was used to assess nursing and midwifery students' knowledge of treatment of DFS using biological material, specifically *Lucilia sericata* larvae. Questions 1 to 5 dealt with sociodemographic data. Question 6 was to find out whether the participants had a family member with diabetes. Question 7 aimed to discover whether the participants thought they had enough knowledge about the treatment of DFS, while the next question examined whether the study participants would like to increase their knowledge about treatment methods for DFS. Question 9 aimed to identify the main source of knowledge about treatment methods for DFS and question 10 surveyed which sources respondents trusted the most. Ques-

tion 11 determined whether sufficient information about techniques and treatments for DFS had been provided during their study. The next question asked whether more material on treatment methods for DFS were needed in the course of their study. Question 13 was multiple choice and was designed to determine the level of familiarity of the study participants with the techniques for treating DFS generally, and question 14 examined their knowledge on modern methods of treating DFS. Questions 15 to 24 addressed knowledge of larvotherapy, and the final two questions, sought to determine whether the study participants would opt for larvotherapy and, if not, why not.

Statistical analyses

For qualitative variables, the frequency (i.e. percentage) was determined and variables expressed at the ordinal or nominal level were analyzed using tests based on the chi-square distribution. For 2×2 tables, a continuity correction was applied, and a Fisher's exact test with expansions for tables larger than 2×2 was used for data that did not meet conditions for Chi-square tests whereas when the conditions for using the chi-square test were not met.

In order to assess the level of knowledge in the techniques and methods of treatment of DFS, as well as in the field of biosurgery, points awarded for correct answers to questions 13 and 14, and 19-23 were summed. In single-choice questions, one point was awarded for indicating the correct answer, while for multiple-choice questions, one point was awarded for indicating each correct answer and also for not indicating an incorrect answer. The more points obtained in total, the higher was the level of knowledge of the respondents. The number of points possible to obtain was between 0-13 points for treatment methods and techniques and 0-12 points for biosurgery. After standardizing the point scores to 100, the percentage of correct answers was obtained. These results were divided into ranges, namely the lowest level (up to 40% correct answers), average level (41-60% correct answers), and highest level (more than 60% correct answers).

Values where $p \leq 0.05$ were considered statistically significant. Analyses were performed using R v.3.6.0, PSPP and MS Office 2019.

RESULTS

Sociodemographic data and clinical characteristics of respondents

Women dominated the study, accounting for 96.5% (n=195) of the participants. The largest

group were young people aged 18-25 years, at 67.8% (n=137). People living in rural areas made up 24.8% (n=50) of the students. Among the respondents, there was an even segregation between nursing students, constituting 50.5% (n=102), and midwifery students, making up 49.5% (n=100). Taking into account the year of study, the largest group were students in the second and third year of their first degree studies at 24.3% (n=49). Among the respondents, 49% (n=99) had a family member with diabetes (Table 1).

Table 1. Sociodemographic data of the participants (n=202)

Variable		n	%	
Gender	women	195	96.5	
	men	7	3.5	
Age	18-25 years	137	67.8	
	26-35 years	45	22.3	
	36-45 years	16	7.9	
	over 45 years	4	2.0	
Place of residence	urban	152	75.2	
	rural	50	24.8	
Direction of study	nursing	102	50.5	
	obstetrics	100	49.5	
Year of study	BA	I year	20	9.9
		II year	49	24.3
		III year	49	24.3
	MA	I year	40	19.8
		II year	44	21.8
A family history of diabetes	yes	99	49.0	
	no	103	51.0	

Legend: BA – bachelor's degree; MA – master's degree; n – group quantity; % – percentage.

Students' knowledge of treatment methods and techniques for DFS

Our analysis demonstrated that students' knowledge of the methods and techniques for treating DFS was varied. The most numerous group of students were the respondents with the highest level of knowledge regarding treatment for DFS at 39.2% (n=79). The lowest level of knowledge was found in 32.7% (n=66) of students and the average level of understanding was 28.2% (n=57). Those representing the highest level of knowledge of biosurgery constituted 48% (n=97) of the group. Students with an average level of knowledge constituted 45% (n=91), while those with the lowest level of knowledge made up 6.9% (n=14) (Table 2).

A detailed analysis of students' knowledge of DFS treatment techniques and biosurgery demonstrated that the most familiar treatment technique for DFS

Table 2. Level of knowledge of DFS treatment techniques and biosurgery (n=202)

Variable		n	%
Level of knowledge of treatment techniques for DFS	lowest	66	32.7
	average	57	28.2
	highest	79	39.2
Level of knowledge about biosurgery	lowest	14	6.9
	average	91	45.0
	highest	97	48.0

Legend: n – group quantity; % – percentage.

was surgical wound debridement, recognized by 52% of participants (n=105). Respondents also frequently selected silver dressings (49%; n=99) and hydrocolloid

dressings (45.5%; n=92) as their familiar DFS treatment techniques. Interestingly, some respondents (10%; n=21) were not aware of any treatment techniques for DFS. Respondents indicated negative pressure therapy as the most familiar modern treatment for DFS (44.6%; n=90). Larvotherapy was indicated by 38.6% (n=78), although no modern treatments for DFS were known to 20.3% (n=41). Among the respondents, 49.5% (n=100) correctly marked dressings used in biosurgery. Very good wound cleansing as an advantage of biosurgery was indicated by the majority (64.4%; n=130) of the respondents. Students in 72.3% (n=96) correctly indicated the facility where maggots are inserted into the wound, and 47.5% (n=96) stated that after insertion of maggots into the wound, it is

Table 3. Detailed results regarding knowledge of DFS treatment and biosurgery techniques and methods (n=202)

Variable		n	%
Treatment techniques	strategia TIME	71	35.2
	hydrofiber dressings	88	43.6
	hydrocolloid dressings	92	45.5
	surgical debridement	105	52.0
	silver dressings	99	49.0
	vascular treatments	69	34.2
	amputation of a limb	75	37.0
	I don't know of any	21	10.0
Modern treatment methods	negative pressure dressings	90	44.6
	larvotherapy	78	38.6
	hyperbaric oxygen	83	41.1
	skin graft	53	26.2
	I don't know of any	41	20.3
Dressings used in biosurgery	closed	26	12.9
	open	74	36.6
	closed and open	100	49.5
	I don't know	2	1.0
Benefits of biosurgery	very good wound cleansing	130	64.4
	decontamination of the wound environment	86	42.6
	reduction of antibiotic-resistant bacteria	85	42.1
	stimulation of wound healing	125	61.9
	removal of complex bacterial structures	119	58.9
Institution inserting maggots into the wound	hospital – in the operating theatre	53	26.2
	patient's home	40	19.8
	biosurgery clinics	146	72.3
	hospital – in the surgical ward	94	46.5
Need to be in a hospital setting	in each case	41	20.3
	there is no need	96	47.5
	I don't know	65	32.2
Source of larvae used for biosurgery	collected from free-flying fly eggs	1	0.5
	bred under sterile conditions in Poland	162	80.2
	bred in high-income countries	38	18.8
	I don't know	1	0.5

Legend: n – group quantity; % – percentage.

necessary for the patient to remain in the hospital setting. The vast majority of respondents (80.2%; n=162) correctly indicated the site of production of larvae used in biosurgery (Table 3).

Relationship between year and field of study and opinion on having sufficient knowledge of techniques and treatments for DFS

The analysis showed that first-year BA students were most likely to believe that they did not have sufficient knowledge (75%; n=15) of DFS treatment techniques and methods. Furthermore, there was no

significant difference between the year of study and the self-generated opinion of having sufficient knowledge in the techniques and methods of treating DFS ($p=0.136$). Nursing students were significantly more likely than midwifery students to believe that their knowledge of DFS treatment techniques and methods was insufficient ($p=0.016$) (Table 4).

Nursing and midwifery students' source of knowledge on techniques and treatments for DFS

Nursing students most often (60.8%; n=62) drew their knowledge of treatment methods from studies

Table 4. Relationship between year and field of study, and the opinion of having sufficient knowledge of DFS treatment techniques and methods

Variable			Year of study					Chi ² test
			BA (year)			MA (year)		
			I	II	III	I	II	
Having sufficient knowledge	Yes	n	5	26	18	19	15	$\chi^2=6.993$ df=4 p=0.136
		%	25.0	53.1	36.7	47.5	34.1	
	No	n	15	23	31	21	29	
		%	75.0	46.9	63.3	52.5	65.9	
Total		n	20	49	49	40	44	
		%	100.0	100.0	100.0	100.0	100.0	
Variable			Direction of study				Chi ² test	
			Nursing n=102		Obstetrics n=100			
Having sufficient knowledge	Yes	n	33		50		$\chi^2=5.788$ df=1 p=0.016	
		%	32.4		50.0			
	No	n	69		50			
		%	67.6		50.0			

Legend: BA – bachelor's degree; MA – master's degree; n – group quantity; % – percentage; χ^2 .

Table 5. Relationship between field of study and knowledge of techniques and treatment methods of DFS, and biosurgery

Variable			Direction of study		Chi ² test
			Nursing n=102	Obstetrics n=100	
Level of knowledge of treatment techniques for DFS	lowest	n	25	41	$\chi^2=27.524$ df=2 p=0.001
		%	24.5	41.0	
	average	n	19	38	
		%	18.6	38.0	
	highest	n	58	21	
		%	56.9	21.0	
Level of knowledge about biosurgery	lowest	n	6	8	$\chi^2=1.376$ df=2 p=0.503
		%	5.9	8.0	
	average	n	43	48	
		%	42.2	48.0	
	highest	n	53	44	
		%	52.0	44.0	

Legend: n – group quantity; % – percentage; χ^2 – test statistic Chi²; df – degrees of freedom; p – statistical significance.

and medical literature, and were more likely to do so when compared to midwifery students ($p=0.001$). Midwifery students most often drew their knowledge from other sources, such as doctors/nurses/midwives, internet, television and family (75%; $n=75$).

Relationship between field of study and knowledge of techniques and treatment methods DFS and biosurgery

Our analysis demonstrated that nursing students had significantly greater knowledge of DFS treatment techniques and methods than midwifery students ($p=0.001$). We found no significant difference in knowledge of biosurgery between nursing and midwifery students ($p=0.503$) (Table 5).

DISCUSSION

The present study analyzed the level of knowledge of nursing and midwifery students on methods and techniques of treating DFS using *Lucilia sericata* larvae. First of all, it should be noted that only slightly more than 1/3 of the students had the highest level of knowledge in this area. Conversely, when examining biosurgery in general, students representing the highest level of knowledge accounted for 48%. It should be emphasized that these future nurses and midwives will play an important role in prevention and/or education activities, regardless of the place of work.

There are no studies in the available literature on assessing the level of knowledge of students about larvotherapy, and few relating to knowledge of treatment techniques for DFS. Therefore, we will discuss our results in the more general context of knowledge about type 2 diabetes and DFS management. In a study by Abdulwassi et al. (2020) on knowledge of diabetic foot management among medical students in Saudi Arabia, the level of knowledge displayed was very high. Fifth-year students had the highest level of knowledge in this study, while fourth-year students had the lowest. According to the authors, the level of students' knowledge should be higher, and this can be achieved by increasing physical examination classes and encouraging them to take an active part in practical classes [14]. In the authors' study, the second-year students believed that they had the highest level of knowledge, while the first-year students were of the opinion that they had the lowest level of knowledge. It seems that the knowledge of students majoring in nursing and midwifery in our investigation could be improved by increasing the hours of practical classes in specialist wards involved in the treatment of DFS. Changes in the curriculum

could also include expanding the scope of classes to include modern treatment techniques for DFS.

A study conducted by Kłys and Gerstenkorn (2005) assessed the level of knowledge of female nursing students about type II diabetes. In this study, most students felt that the problem of diabetes was not sufficiently discussed during their university classes, and the graduating students felt that their knowledge was insufficient for future work as patient educators. Almost all participants indicated a willingness to improve their knowledge in this area [15]. Similar results were obtained in our study, with 55.4% ($n=112$) of the students indicating that their studies on the methods of treatment of DFS was insufficient. A large proportion of the respondents (88.1%; $n=178$) expressed a desire to expand their knowledge, and 58.9% ($n=119$) of the students felt that they did not have sufficient knowledge about modern methods of DFS treatment. In a study by Karłowicz et al. (2010) on the assessment of the level of knowledge about DFS in type II diabetic patients, it was noted that a well-educated nursing team is critical to improve patient education regarding disease complications [16]. Similar results were obtained in a study by Graffigna et al. (2016), in which the authors evaluated the role and ability of healthcare professionals in motivating patients to self-care and self-management in type II diabetes. This study indicated that an involved healthcare team resulted in them being viewed as good educators [17]. The attitudes of the students in our study indicate a desire to increase their own knowledge about the treatment of DFS. Greater knowledge among future nurses and midwives may result in a reduction in the incidence of diabetic complications, improved patient function and a reduction in hospital visits.

The level of knowledge regarding diabetes and related factors of Chinese students was assessed by Zang et al. (2016), who found that students who had a family member with diabetes showed higher levels of knowledge [18]. Similar results were obtained by Amankwah-Poku (2019) who analyzed knowledge and awareness of type II diabetes among a student population in Ghana [19]. Interestingly, our study demonstrated that students with the highest level of knowledge were both with (47.6%; $n=49$), and without (48.5%; $n=48$) a family member with diabetes. Similar results were obtained in a study by Dąbska and Żońnierczuk-Kieliszek (2016) [20], suggesting that having a diabetic person in the family of the student is not important for the student's knowledge.

In a study on diabetes knowledge among university students in Ajman in UAE, Khan et al. (2012) reported that students used a variety of sources to gain knowledge about diabetes. The most frequently chosen source was information obtained from friends and relatives with 79%, and television and the Inter-

net with 7% [21]. In this study, the main sources of knowledge of nursing students about the treatment of DFS were university classes and medical literature (60.8%; n=62), while midwifery students by far the most frequently drew this knowledge from other sources (75%; n=75). This indicates that students in our study are obtaining knowledge on DFS from reliable sources such as college classes. The Internet, to which students now have easy access, actively increases students' awareness of biosurgery, with many medical articles available on the web. However, noting the level of students' knowledge of biosurgery could definitely be higher, more effort should be made to ensure that knowledge is taught more during college classes. The Internet would be an additional source of knowledge in this field, based solely on medical articles.

The results of the study indicate the need for further research on the knowledge of methods and techniques of treatment of DFS and biosurgery in the group of nursing and midwifery students. It is also reasonable to consider the need to carry out educational activities for students and to increase the number of hours of practical classes in specialist departments. It is important that the knowledge of future nurses and midwives is at the highest possible level, because education and medical care plays

a very important role in preventing the occurrence of complications of diabetes in patients.

Limitations and future directions

The limitations of this study include the relatively small sample size, and that it was conducted among students at one institution, which may limit the generalization of results. In the future, we plan to conduct a multi-center study that will include nursing and midwifery students from other universities in Poland.

CONCLUSIONS

The research presented in this study indicates that nursing and midwifery students have insufficient knowledge of DFS treatment methods and biosurgery. Nursing students are more likely than midwifery students to derive knowledge of DFS treatment methods from their studies and the literature. Education among students on treatment methods and techniques for DFS should be increased. Students' knowledge can be increased by classes in the course of their education and meetings with professionals.

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