



# Geographic variability of major non-traumatic lower limb amputations in diabetic and non-diabetic patients in Poland

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## Abstract

**Introduction.** High amputation of the lower limb not only causes immense physical disability but also the destruction of the patient's mental state, and helps to shorten life of patients with diabetes. The incidence of amputations in diabetic patients is 10 times higher in comparison to non-diabetic subjects (2.8% vs. 0.29%). The purpose of the study is an analysis of the geographic variability of major non-traumatic lower limb amputation in diabetic and non-diabetic patients in Poland.

**Materials and method.** All major non-traumatic lower limb amputations performed for the first time, in particular databetween 1 January 2013 – 31 December 2013, and between 1 January 2014 – December 2014, were identified in the National Health Fund (NHF) database. In the presented study, the patients were grouped in relevant provincial departments of the NHF according to their place of residence, and not according to the hospital where lower limb amputation was performed.

**Results.** In 2013 in Poland, 4,727 major non-traumatic lower limb amputation were performed in diabetic patients, and 4,350 in 2014. On the other hand, in non-diabetic patients, 3,469 major non-traumatic lower limb amputations were performed in 2013, and 3149 in 2014. The mean number indicator of major non-traumatic lower limb amputations in diabetic patients in Poland, compared to the average indicator of amputations in patients without diagnosed diabetes in Poland was 19.9-fold in 2013 and 19.4-fold higher in 2014.

**Conclusions.** In populations of diabetic patients and individuals without diagnosed diabetes major non-traumatic lower limb amputations are performed over 19-fold more frequently.

## Key words

diabetes mellitus, diabetic patients, non-diabetic patients, non-traumatic lower limb amputations

## INTRODUCTION

High amputation of the lower limb not only causes immense physical disability, but also contributes to the destruction of the patient's mental state, and helps to shorten life of patients with diabetes [1,2].

The incidence of amputations in diabetic patients is 10 times higher in comparison to those non-diabetic (2.8% vs. 0.29%) [3]. The number indicator of amputations per person per 100 thousand population per year worldwide are very diverse, and range from 2.8/100,000 Madrilenians in Spain to 43.9/100,000 Navajo residents in the USA [4]. Regardless of the different number indicators of amputations in different parts of the world, the diversity of the indicators mentioned above within the same country in diabetic and non-diabetic patients have also been described. Wrobel et al. presented observations about the volatility of major lower limb amputations in 306 centres in the USA, and found that the number indicator of major amputations per number of residents varied 8.6-fold [5]. Data from the UK indicates an

approximately 2-fold higher incidence of major lower limbs amputations in diabetic patients between centres [6].

**Patients and methods.** Health care services in Poland are financed by the National Health Fund under the Act [7] and the Minister of Health Regulation arising therefrom [8,9]. The treatment of diabetic foot syndrome is carried out under a contract to perform services for inpatients under a 'hospital's contract'. The organization, financing and accounting for services are determined by the Ordinances of the President of the National Health Fund [10,11,12]. Along with the introduction of the JGP settlement system (homogeneous group of patients) in 2008, therapy financing is accounted in the JGP system. In order to perform analyses on reporting data held in NFZ databases, SQL (Structured Query Language) queries to databases were made with the unique the PESEL – patient's identification number taken into consideration [13]. Data clarification was performed in three stages:

1) Selection of patients' PESEL numbers, in whom in 2013 and 2014 services with the ICD-10 code indicating diabetes were present, or in this time the patient filled a prescription for any drug from the group A10 AX (insulin), A10 BX (oral hypoglycaemic agents), and specialized diagnostic tests (strips), or others who were not diagnosed with diabetes.

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2) For PESEL numbers that were the results of SQL queries, it was checked which PESEL numbers had reported the following procedures: 5.51.01.001.0039 K39 – diabetic foot, 5.51.01.008072 H72 – extensive and major amputations, or 5.51.01.008073 H73 – minor amputations. Data were analyzed with the use of the following software: SQL, Excel and Statistica 10.

3) Demographic data on particular provinces were obtained from the Central Statistical Office in Warsaw.

All major non-traumatic lower limbs amputations performed for the first time, in particular between 1 January 2013 – 31 December 2013, and data between 1 January 2014 – 31 December 2014 were identified in the National Health Fund database. In 2013 in Poland, there were 8,096 major non-traumatic lower limbs amputations performed for the first time, and 7,499 in 2014.

In this study, patients were grouped in relevant provincial departments of the National Health Fund according to their place of residence, and not according to the hospital where the lower limb amputation was performed. In 2013, it was not possible to establish the place of residence of 143 patients – 21 with diabetes and 122 non-diabetic, whereas in 2014, it was not possible to establish the place of residence of 147 patients – 27 with diabetes and 120 non-diabetic.

## RESULTS

The number of unique patients' PESEL numbers, in whom all major non-traumatic lower limbs amputations were performed for the first time, in particular in 2013 and 2014, are shown in Table 1.

**Table 1.** Total number of major non-traumatic lower limbs amputations performed for the first time in a particular year in Poland in 2013 and 2014, according to National Health Fund database

	2013			2014		
	Male	Female	Total	Male	Female	Total
Diabetic patients	2,765	1,862	4,627	2,644	1,706	4,350
Non-diabetic patients	2,371	1,098	3,469	2,038	1,111	3,149
Total	5,136	2,960	8,096	4,682	2,817	7,499

In 2013 in Poland, 4,627 major non-traumatic lower limbs amputations were performed in diabetic patients, and 4,350 were performed in 2014. On the other hand, in non-diabetic patients, 3,469 major non-traumatic lower limbs amputations were performed in 2013, and 3,149 in 2014. The percentage of major non-traumatic lower limbs amputations in diabetic patients in 2013 accounted for 57.15% of the total lower limbs amputations performed. In 2014, this percentage was 58%. The percentage of female patients in whom major lower limb amputation was performed, was 40.24% in 2013 and 39.22% in 2014. On the other hand, percentage of non-diabetic female patients in whom major lower limb amputation was performed, was 31.65% in 2013 and 35.28 in 2014.

The number indicators of diabetic patients numbers in whom major non-traumatic lower limbs amputations were performed in particular years per 1,000 diabetic patients, taking into account various provinces in Poland in 2013 and 2014, are presented in Table 2.

**Table 2.** Indicators of major non-traumatic lower limbs amputations performed for the first time in particular year per 1000 patients with diagnosed diabetes in Poland, according to National Health Fund database in 2013 and 2014

National Health Fund Department	2013	2014
1. LOWER SILESIA	2.19	1.89
2. KUYAWA-POMERANIA	2.03	1.68
3. LUBLIN	2.18	1.84
4. LUBUSKI	2.00	1.87
5. ŁÓDŹ	1.65	1.63
6. LESSER POLAND	1.67	1.54
7. MAZURIA	1.65	1.42
8. OPOLE	2.38	2.52
9. SUBCARPATHIA	1.98	1.75
10. PODLASKA	1.99	1.33
11. POMERANIA	2.17	1.91
12. SILESIA	2.27	2.17
13. ŚWIĘTOKRZYSKA	1.81	1.66
14. WARMIA-MAZURIA	1.95	1.57
15. GREATER POLAND	2.00	1.85
16. WEST POMERANIA	1.94	1.57
MEAN IN POLAND	1.9 ± 0.2	1.7 ± 0.3

Data presented as mean ± standard deviation

The mean number of patients per 1,000 patients with diagnosed diabetes, in whom major non-traumatic lower limbs amputations were performed, was  $1.9 \pm 0.2$  in 2013 and  $1.7 \pm 0.2$  in 2014, respectively.

In some provinces in Poland, higher rates of major amputations were observed in 2013, compared to the average country indicators. Among them were the provinces of Opole – 2.38/1,000 patients, Silesia – 2.77/1,000 patients, Lower Silesia – 2.19/1,000 patients and Lublin – 2.18/1,000 patients. In contrast, a lower number indicators of major amputations in diabetic patients, compared to the average country indicators, were observed in the following provinces: Mazuria – 1.65/1,000 patients, Łódź – 1.65/1,000 patients and Lesser Poland – 1.67/1,000 patients.

A higher than average country number indicators of major non-traumatic amputations in diabetic patients in 2014 were observed in the following provinces: Opole – 2.52/1,000 patients, Silesia – 2.17/1,000 patients, Lower Silesia – 1.89/1,000 patients and Lublin – 1.84/1,000 patients. In contrast, lower number indicators of major amputations compared to the country average were recorded in the following provinces: Podlaska – 1.33/1,000 patients, Mazuria – 1.42/1,000 patients, Lesser Poland – 1.54/1,000 patients, Warmia-Mazuria – 1.57/1,000 patients, Łódź – 1.63/1,000 patients and Świętokrzyska – 1.66/1,000 patients. The mean indicator of major non-traumatic amputations in diabetic patients in Poland was reduced by 12% in 2014, compared to 2013. The indicator of major non-traumatic lower limbs amputations performed for the first time, in particular years per 1,000 residents without diagnosed diabetes, taking into account particular provinces, are shown in Table 3.

The mean number indicator of major non-traumatic lower limbs amputations in non-diabetic patients in 2013 amounted  $0.09 \pm 0.01/1,000$  population residents, whereas the mean

**Table 3.** Indicator of major non-traumatic lower limbs amputations performed for the first time in particular year/1,000 residents without diagnosed diabetes in Poland, according to National Health Fund database in 2013 and 2014.

National Health Fund Department	Year 2013	Year 2014
1. LOWER SILESIA	0.09	0.1
2. KUYAVA-POMERANIA	0.1	0.08
3. LUBLIN	0.1	0.1
4. LUBUSKA	0.1	0.09
5. ŁÓDŹ	0.09	0.08
6. LESSER POLAND	0.08	0.07
7. MAZOVIA	0.08	0.08
8. OPOLE	0.1	0.1
9. SUBCARPATHIA	0.09	0.09
10. PODLASKA	0.1	0.09
11. POMERANIA	0.1	0.08
12. SILESIA	0.1	0.1
13. ŚWIĘTOKRZYSKA	0.1	0.09
14. WARMIA-MAZURIA	0.09	0.08
15. GREATER POLAND	0.08	0.07
16. WEST POMERANIA	0.1	0.09
MEAN IN POLAND	0.09 ± 0.01	0.08 ± 0.01

Data are presented as mean ± standard deviation

indicator lowered to  $0.08 \pm 0.01/1,000$  population residents in 2014.

The mean number indicator of major amputations was higher than the average country indicator in 2013 in the following provinces: Lublin – 0.1/1000 residents, Lubuska – 0.1/1,000 residents, Opole – 0.1/1,000 residents, Podlaska – 0.1/1,000 residents, Pomerania – 0.1/1,000 residents, Silesia – 0.1/1,000 residents, Świętokrzyska – 0.1/1000 residents and West Pomerania – 0.1/1000 residents.

Lower number indicators of amputations compared to the average country indicator in 2013 were observed in the following provinces: Mazuria – 0.08/1,000 residents, Greater Poland – 0.08/1,000 residents, Lesser Poland – 0.08/1,000 residents, Łódź – 0.09/1,000 residents, Sub-Carpathia 0.09/1,000 residents, Warmia-Mazuria – 0.09/1000 residents, and Lower Silesia – 0.09/1,000 residents.

Higher number indicators of major amputations compared to the average country indicator in 2014 were observed in the following provinces: Silesia – 0.1/1,000 residents, Lower Silesia – 0.1/1,000 residents, Lublin – 0.1/1,000 residents, Opole – 0.1/1,000 residents and West Pomerania – 0.1/1,000 residents.

Lower number indicators of major amputations compared to average indicators of the country in 2014 were observed in the following provinces: Lesser Poland – 0.07/1,000 residents, Greater Poland – 0.07/1,000 residents, Kuyava-Pomerania – 0.08/1,000 residents, Łódź – 0.08/1,000 residents, Mazuria – 0.08/1,000 residents, Pomerania – 0.08/1,000 residents and Warmia-Mazuria – 0.08/1000 residents.

Mean number indicator of major non-traumatic lower limbs amputations in diabetic patients in Poland, compared to the average indicator of amputations in patients without diagnosed diabetes in Poland was 19.9-fold in 2013, and 19.4-fold higher in 2014.

## DISCUSSION

Variability of the number indicator of major non-traumatic lower limbs amputations has been repeatedly described [14, 15]. The incidence of lower limbs amputations in diabetic patients in Holland varied 4-fold, whereas in non-diabetic individuals 2-fold in different parts of the country [15]. Holman et al. presented the variability of both major and minor lower limbs amputations incidence in the UK. During a 3 year period, 34,109 amputations were reported, among them 16,693 (48.9%) in diabetic patients. Number indicator of amputations varied from 0.64 – 5.25 per year per 1,000 diabetic patients, and from 0.03 – 0.24/1000 non-diabetic patients per year. Indicator of major amputations in diabetic patients in the UK varied from 0.22 – 2.2 per 1,000 patient-years [16].

In a previous study on number indicators of major non-traumatic lower limbs amputations in diabetic patients in Poland between 2009 – 2012, differences were found between particular provinces which, however, were not as high as those in the UK and Holland, because the indicators were % higher or % lower in particular provinces, compared to average country [indicators 17].

In contrast, number indicators of major amputations in non-diabetic individuals, compared to the average country indicator of particular provinces were 1/3 higher or 1/5 lower [18]. In research by the authors of the current study, number indicators of major amputations in diabetic patients in Poland in 2013 were 1/4 higher in particular regions of the country, and lower in others.

In contrast, mean number indicators of major lower limbs amputations in 2014 in Poland changed by 12%. Differences of number indicators of major non-traumatic lower limbs amputations in 2014 in particular regions of Poland were 1/5 higher and 1/4 lower in others, compared to the average country indicator. Comparison of the number indicator of major amputations in individuals without diagnosed diabetes in Poland in 2013 with average indicator of amputations in Poland, showed that this indicator was 1/5 higher in particular provinces, and % lower in the others. In contrast, correspondingly this indicator in 2014 was 1/5 higher in particular provinces, and 1/10 lower in others.

The number of amputations in every country depends on many factors, but one of the most important is the total funding for health care. For instance, in Denmark, Holland and Sweden, where funding for health care is multiple higher, the number of amputations is significantly lower.

In recent years in Poland, the number of major non-traumatic amputations in diabetic patients decreased from 3,972 in 2009 to 3,149 in 2014. At the same time, the number of non-traumatic lower limbs amputations in diabetic patients increased from 3,731 in 2009 to 4,350 in 2014 [17,18]. Early revascularization interventions allows a significant reduction in the number of lower limbs amputations in diabetic patients with diabetic foot, mainly of vascular origin, and in non-diabetic patients with lower limbs atherosclerotic arterial disease.

The presence of differences in number indicators of lower limbs amputations depends on the number of diabetic patients, therapeutic approach, maintaining a register, demographic differences in each country, availability of therapeutic methods, as well as on the differences in races present in a particular country, availability of diabetic foot

outpatients, of prophylaxis, and highly specialist treatment [19,20,21].

## CONCLUSIONS

1. Presence of indicators of major non-traumatic lower limb amputations in 2013 and 2014, both in diabetic and non-diabetic patients, shows variations depending on province.
2. During the last two years there has been decrease in the average indicator of major non-traumatic lower limbs amputations in Poland, from 1.99/1,000 patients to 1.75/1,000 diabetic patients in 2013.
3. During the last two years there has been a decrease in the average indicator of major non-traumatic lower limbs amputations in Poland from 0.09/1000 patients to 0.08/1000 patients without diagnosed diabetes.
4. In Poland in 2013–2014, in the population of patients with diabetes, major non-traumatic lower limb amputations were performed 19 times more often than in the population of patients without diabetes.

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