EDITORIAL

Amputation Statistics—How to Interpret Them?

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Editorial to accompany the article: "Lower Limb Amputation in Germany—An Analysis of Data From the German Federal Statistical Office Between 2005 and 2014" by Knut Kröger et al. in this issue of *Deutsches Ärzteblatt International*

The prevalence of diabetes mellitus in Germany is approx. 10% (1). Diabetic foot syndrome (DFS) has become the principal cause of major amputations. Peripheral arterial occlusive disease (PAOD) without accompanying diabetes is also steadily increasing (2), but results in up to 30 times fewer amputations than DFS (3). Lower-limb amputations are associated with decreased life expectancy, lower quality of life, and high treatment costs (4). Reliable data on the incidence of amputation are therefore of great importance for health policy and economics in the effort to bring about structural improvements in the care of people with diabetes and/or PAOD.

Amputation rates

Based on hospital discharge data, the total number of lower-limb amputations in Germany in the year 2001 was estimated to be over 43 000; 70% of these operations were carried out in persons with diabetes (5). In 1990, according to the Leverkusen Amputation Reduction Study (6), the incidence of amputation for the whole population of Germany was 33/100 000 inhabitants per year (standardized rates: 7/100 000 in persons without, 224/100 000 for persons with known diabetes mellitus; relative risk: 32). The same study showed a reduction of 37% in all lower-limb amputations proximal to the toes in the diabetic population between 1990 and 2005, with no change in the nondiabetic population over the same period (6). Among persons covered by one German health insurance provider, those with diabetes had a fivefold greater risk of major amputation in the observation period 2005 to 2007 than those without a diagnosis of diabetes (7).

Kröger and co-authors (8) now report the findings of their analysis of hospital discharge data supplied by the German Federal Statistical Office. Vascular-related major amputations of the lower limb decreased by 31% between 2005 and 2014, while minor amputations increased by 25%. This study is of great practical value: on the one hand it lucidly portrays the true extent of the amputation problem in Germany, and on the other hand it shows a positive trend towards lower numbers of major amputations year on year. The data are in agreement with the above-mentioned German studies (6, 7) and with international investigations (3).

The structure of the raw data is responsible for the fact that the authors are unable to state exactly which

at-risk population benefited and why that was so. For instance, improvements in healthcare structures with regard to DFS, or advances in vascular medicine may have played a role.

Problems in comparing results

The study (8) also clearly shows the complications involved in comparing findings on amputation rates in at-risk populations. One problem, for example, is variation in definition of the level at or above which amputation is defined as "major":

- through or proximal to the ankle joint
- above the tarsus
- through the line of the tarsometatarsal joints.

The German diagnosis-related groups (G-DRG) system arbitrarily defines the Syme procedure, actually a distal lower-leg amputation, as a minor amputation. Amputations in the vicinity of the ankle joint, which can be defined as minor or major, comprise 6% of all amputations in Germany (www.destatis.de). If amputation levels are not classified uniformly, the results of different studies on amputation incidence cannot be compared.

Calculation of the incidence of amputation in diabetics and nondiabetics requires knowledge of the prevalence of diabetes in the reference population. There are also studies that discuss amputations in diabetics in terms of the total population rather than the diabetic population, but the incidence is hard to interpret without knowing the prevalence of diabetes. The number of people with undetected diabetes is high (1), and it is very difficult to identify diabetics with absolute certainty.

The literature on amputation incidence shows considerable variation. Apart from differences between regions or countries, the reason may lie in the various ways of counting amputations. In other words, one needs to know which of the following parameters was used to determine incidence:

- all amputations
- hospital stays during which one or more amputations were carried out
- individuals with at least one amputation in a defined period
- individuals with a first amputation.

Knowledge of the duration of the event-free interval before amputation is also important, in order not to overestimate the incidence of first amputations in the

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observation period. It must also be clear what amputations were recorded: all (major and minor) or only major amputations, only vascular-related amputations, or amputations for any reason.

All this makes it difficult to compare the results of different studies. Thus, the incidence of amputation (not including toe amputation) in diabetics in the year 2011 varied between 1 and 18.4/100 000 among 26 OECD countries (9). Worldwide, the reported incidence of major amputation between 1989 and 2010 ranged from 3.6 to 68.4/100 000 in the normal population and from 5.6 to 600/100 000 in diabetics (3). Such figures are confusing and hard to interpret. In contrast, the results described by Kröger et al. are less complicated and easier to grasp. An ongoing systematic review of the literature is intended to provide more clarity (10).

Conclusion

The study by Kröger et al. (8) shows that the total annual number of major amputations in Germany has gone down since 2005 despite the increased number of patients at risk (DFS, PAOD). This important finding suggests that therapeutic behavior with regard to amputations must have changed. On the basis of the data supplied by the Federal Statistical Office, however, the authors were not able to precisely assign the amputations to individual subgroups of patients (primarily ischemic, neuroischemic, or neuropathic DFS).

To establish internationally comparable rates of incidence for amputations that also depict changes over the course of time, we need population-based studies with uniform definitions (e.g., of amputation level) in which diabetic and nondiabetic populations are identified by means of evaluated algorithms. Until harmonization of terminology—one of the aims of the national diabetes surveillance program in Germany—is achieved, amputation statistics should be interpreted and communicated cautiously and in context.

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Conflict of interest statement

The authors declare that no conflict of interest exists.

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