

Leg and Foot Ulcer Prevalence and Investigation of the Peripheral Arterial and Venous Circulation in a Randomised Elderly Population

An Epidemiological Survey and Clinical Investigation

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Five thousand one hundred and forty questionnaires concerning leg ulcers were sent to a randomly selected population aged 65 years and older in Gothenburg in April 1989. The response rate was 89%. Ninety-seven individuals answered affirmatively, that they had leg ulcers, which corresponds to a prevalence of 2.15 ± 0.42 per cent. These 97 individuals and the same number of controls were asked to come for a medical examination with tests of the peripheral circulation and an interview. Seventy-five (of the 97) were examined. Thirty-five had leg or foot ulcers caused by vascular insufficiency and/or diabetes and the true prevalence was estimated to be 1.02 ± 0.29 per cent. Key words: Epidemiology; Questionnaires; Plethysmography.

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In clinical practice leg and foot ulcers are a common ailment. In a previous study, based on medical records from patients seeking medical care for their leg and foot ulcers, the prevalence was estimated to be 0.32 per cent (0.2-0.4) in the whole population. The percentage of the population with leg and foot ulcers increases exponentially with age (1).

Chronic leg and foot ulcers are defined as ulcers on the feet and/or legs. Difficult to heal, they are generally regarded as caused by vascular insufficiency with or without diabetes. Excluded ulcers are, for instance, excoriations from pruritic skin diseases and skin cancers.

The purpose of this survey has been to estimate the leg and foot ulcer prevalence in an elderly randomly selected population, investigated by questionnaires and medical examination, and to determine the prevalence of peripheral arterial or venous insufficiency and related symptoms in persons with ulcers compared with controls.

PATIENTS AND METHODS

The whole population in Gothenburg in 1989 was 430,763 and 19% were older than 65 years of age (2). From these, 5140 elderly persons were chosen at random in the same age and sex proportions as in the whole population, by DAFA (Stockholm).

A questionnaire was mailed to each person in April 1989. An explanation of the term "leg ulcers" accompanied the questions as follows: "Leg ulcers are situated on the lower legs or feet and are usually caused by altered blood flow. Ulcers that heal quickly in a few weeks after an injury to the skin are not considered to be leg ulcers".

The two main questions were: 1) "Do you have a leg ulcer at the present time?" and 2) "Have you had leg ulcers previously?". Some additional questions were asked if the answer was yes to either of these questions; if the answer was yes to the first question about having a current ulcer, the following was asked: "How long have you had your ulcer?" If the answer was yes to the second question about having ulcers previously, they were also requested to answer: "How many times have you had ulcers?"

If there was no reply to the first questionnaire, a second one was sent. Those persons who did not answer the second questionnaire either are called the non-respondents. To get an estimate of how many of the non-respondents (564) had had ulcers, 30 of them (10 men) were chosen at random and phoned. The persons who answered that they had an ulcer in April 1989 and the same number of persons who answered that they had never had any leg ulcers were invited to come for medical examination, an interview, and investigation of the peripheral circulation and laboratory tests. The site of ulcers, edema, varicose veins and different dermatoses were noted. The sites of the ulcers were classified as medial (inside), lateral (outside), anterior (front), posterior (back), feet or multiple ulcers. Multiple ulcers were situated in more than one location on one limb or in different sites on each leg in the patients with bilateral ulcers. Edema was either found at the examination or the person had a positive history of edema. The interview included questions concerning previous episodes of myocardial infarction, angina pectoris, and if they had varicose veins, hypertension (3), family occurrence of leg ulcers, smoking habits and if they had had an operation for varicose veins. They were also asked about other previous operations (abdominal), or fractures (foot, leg or hip), since silent thrombosis often occurs in connection with operations and fractures (4).

The systolic ankle pressure was measured by Ultrasound Doppler (5). An ankle/arm systolic pressure index (AI) of 0.9 or above was considered normal (6), and if it was below 0.9 further examination with systolic toe pressures (TI) was recommended. The venous peripheral circulation was examined by means of a Varitest apparatus (Eureka, Bromma, Sweden), a computerised strain gauge plethysmograph registering values for RV, t-50 and index (7, 8). The strain gauge sensor cable was applied around the calf and the registration was done during 15 standardised muscle contractions and after rest. The RV (the refilled volume) is the volume of blood pumped out (and thereafter refilled) per 100 ml leg volume at the level of the sensor. A normal RV value is 0.7 or above. The t-50 measures the time when 50 per cent of the RV is refilled and a normal t-50 value is 7 sec or above. The index is the product of t-50 and RV with a normal value of 10 or above. In Tables V and VI the Varitest values (Vv) are considered to be low if any one of these variables was below the values given above. For the assessments, Vv and AI values from the ulcerated legs in persons with leg ulcers and the lowest value in either leg in those without ulcers were used.

The AI, Varitest and assessment of clinical status were performed with the patient supine with the legs horizontal. Twelve persons were not able to participate in the Varitest examination because they were not able to bend the ankle or knee joints or were unable to perform muscle contractions. Ankle pressure measurements were not performed in one leg in 3 persons.

The following laboratory tests were included in the study: haemoglobin, blood glucose and erythrocytes. Normal values for haemoglobin men 132-166 g/l, women 116-149 g/l; erythrocyte counts

Table I. The response rates to the questionnaires (Q) for the men and women and all subjects

	Men	Women	All	% of 5074 respondents and non-respondents
Respondents to the 1st Q	1477	2101	3578	71%
Respondents to the 2nd Q	336	596	932	18%
Non-respondents	191	373	564	11%
Not found	7	15	22	
Deceased	25	19	44	
Total	2036	3104	5140	

men 4.0–5.4 (10**12/l), women 3.9–4.8; blood glucose 3.9–5.8 mmol/l. All examined individuals were informed about the results of the blood tests by mail or telephone.

The Ethical Committee at Sahlgrenska Hospital approved the study.

Statistical methods

From the population in question, a systematic sample was drawn. According to the structure of the data-base giving the sample, the latter was regarded as a simple random one.

Following the plan of Hansen & Hurwitz, the non-respondents were investigated through a randomly selected small sample (9, 10). Proportions for the whole population as well as for large subgroups, male and female, were estimated using both samples. When justified by the sample size, confidence intervals based on the normal distribution were calculated. The possible existence of false positive/negative answers was checked. The final estimate was weighted by sex in order to avoid the effect of varying propensity to answer correctly. For testing the correspondence between the presence of leg ulcers and various clinical variables compared with controls, the chi-square test was used. This method was also used for comparing the blood values in persons with leg ulcers and controls.

RESULTS

The response rates to the first and second questionnaires are shown in Table I. The total response rate was 89% (deceased persons and persons not found excluded).

The 4510 answers to the questions concerning current or previous ulcers are given in Table II. Seventy-five (48 men, 27 women, median age 74 years) of the 97 (58 men, 39 women) persons who answered that they had leg ulcers in April 1989 came for a medical check-up, interview and tests. Thirty-five individuals (19 men, 16 women, median age 77 years) had leg and foot ulcers due to vascular insufficiency and/or diabetes.

Fifty-three per cent (40/75) of the examined persons (29

men, 11 women, median age 73 years) who stated that they had leg ulcers proved to have other diagnoses, see Table III.

One (man) of the 30 non-respondents had had an ulcer in April 1989. None of the 86 controls (54 men, 32 women, median age 75 years) had ulcers.

The prevalences and confidence limits for the men and women in the questionnaires who stated that they had ulcers in April 1989 or previously and the prevalence of ulcers due to vascular insufficiency found after examination are shown in Table IV. The duration of ulcers before April 1989 in the 35 persons with vascular insufficiency ulcers varied from 1 month to 8 years, and they had previously had ulcers 1–3 times.

In Table V the history and some clinical findings in persons with ulcers and a) venous or b) arterial insufficiency are compared with the history and clinical findings in controls. The same person can have both low Vv and low AI and this combination was found in 7 persons with ulcers and in 27 controls. In all persons with ulcers, low Vv was found in 82 per cent (23/28), low AI < 0.9 in 38 per cent (13/34) and diabetes in 23 per cent (8/35). In the controls, low Vv was found in 72 per cent (59/82), low AI < 0.9 in 41 per cent (35/85) and 11 per cent (9/86) had diabetes. In V a) the percentage of persons with a family history of leg ulcers, thrombosis, varicose veins, varicose vein surgery and edema was higher among the persons with ulcers and venous insufficiency compared with the controls. Among the persons with ulcers and arterial insufficiency (low AI), a family history of leg ulcers was found in 27 per cent (3/11), thrombosis in 50 per cent (6/12), varicose veins in 31 per cent (4/13), varicose vein surgery in 23 per cent (3/13) and edema in 42 per cent (5/12). In V b) the percentage of persons with a history of myocardial infarction, angina pectoris and diabetes was higher among the persons with ulcers and arterial insufficiency, compared with the controls. Among per-

Table II. The answers of the 4510 respondents to the questions 1) Do you have an ulcer now? 2) Have you had an ulcer previously?

	1) Yes I have an open ulcer now 2)*	1) No, not now 2) Yes, I have had ulcers previously	1) No 2) No I have never had any leg ulcers	All
Men	58	41	1714	1813
Women	39	94	2564	2697
All	97	135	4278	4510

a) 42 of the 97 who reported an open ulcer in April 1989 had had an ulcer before.

Table III. The diagnoses of the 40 persons who had reported leg ulcers in the questionnaires but proved to have other diagnoses

	Number of persons	(%)
Eczema	18	(45)
Psoriasis	5	(13)
Basal cell cancer	5	(13)
Actinic keratosis	1	(3)
Verrucae vulgaris (sole)	1	(3)
No dermatological findings*	10	(25)
All	40	

* Two persons had arterial insufficiency with low AI of 0.60 in their right legs at the time of examination. Previously but not in April 1989; 2 persons had suffered from eczema, 2 had had skin changes due to excoriations, 1 had had a leg ulcer and 1 a traumatic ulcer.

sons with ulcers and venous insufficiency (low Vv), myocardial infarction was found in 13 per cent (3/23), angina pectoris in 17 per cent (4/23), diabetes in 17 per cent (4/23), and 30 per cent (7/23) were smokers.

The ulcer sites are related to low Vv and AI values in Table VI. Twenty-nine individuals had unilateral ulcers and 6 had bilateral ulcers (41 ulcerated legs).

Low haemoglobin values were found in 26% (9/34) of the persons with leg ulcers, compared with 5% (4/81) of the controls ($p = 0.00266$). High haemoglobin values were found in 9% (3/34) of the individuals with leg ulcers and in 11% (9/81) of the controls.

Low erythrocyte counts were also found more often in the persons with leg ulcers (18% (6/33) compared with 3% (2/80) of the controls) ($p = 0.01071$). High values were found in 6% (2/33) of the individuals with leg ulcers and in 4% (3/80) of the controls.

High blood glucose was found in 21% (7/33) of the persons with leg ulcers, compared with 14% (11/81) of the controls (n.s.).

DISCUSSION

Many problems present when determining the prevalence of leg and foot ulcers in a population. Leg and foot ulcers are mainly an "old people's disease" and the prevalence increases towards the last decades of life (1). In a previous study, 28 per

cent of the leg and foot ulcer patients had died during a follow-up period of 3.5 years. The mortality rate was twice as high for both men and women as in the same age-groups of the population (11).

In a previous study, medical records were analysed retrospectively for one year in the city of Gothenburg. The prevalence found was 0.32 per cent (0.2–0.4). For persons over 65 years of age, the prevalence was 1.22 per cent (1.16–1.27) (12).

In this study we wanted to investigate the prevalences found by postal questionnaires in a randomly selected population and after medical examination. As the expected prevalence for individuals under the age of 65 is low, the number of questionnaires needed to get a representative sample of individuals with leg ulcers would be high. We therefore chose elderly persons over the age of 65 years for this study. Since we only addressed the elderly and we presumed that they might find it difficult to read and answer questionnaires, we tried to provide a questionnaire that was easy to read. The total response rate of 89 per cent is very satisfactory. This suggests that this age-group willingly answers questionnaires, but also that the design of the questionnaire is important (13).

The leg and foot ulcer prevalence calculated from the answers to the questionnaires was about twice as high (2.15 ± 0.42 per cent) as after examination (1.02 ± 0.29 per cent). Many persons who came for the investigation had, for instance, eczema or psoriasis with excoriations, or ulcerated basal cell cancers which they considered to be a leg ulcer.

A prevalence of leg and foot ulcers based solely on data from questionnaires should be regarded with scepticism. It seems to be most important to examine the patients and not only rely on the answers to questionnaires, otherwise the ulcer prevalence figures will probably be too high. The prevalence of vascular leg and foot ulcers agrees well with that in the former study of medical records (1). An advantage of using medical records over questionnaires is that the patients have already been examined and have a diagnosis.

The distribution of different types of leg and foot ulcers in earlier studies is venous ulcers 70–90 per cent, arterial ulcers 5–15 per cent, ulcers caused by both arterial and venous insufficiency 5–10 per cent and other causes 1–15 per cent (14, 15).

In our study, 35 persons had leg and foot ulcers, which includes persons with venous and/or arterial insufficiency, with or without diabetes. In order to examine the venous circula-

Table IV. The prevalences (prev.) of leg and foot ulcers and confidence limits (conf.) in per cent in persons above the age of 65 according to questionnaires (Q) and after medical examination. Calculations for the non-respondents have been included in the values in brackets () for persons with vascular insufficiency and ulcers.

	Prev. of reported open ulcers in Q	Conf. limits \pm	Prev. of reported ulcers at an earlier event	Conf. limits \pm	Prev. of ulcers due to vascular insufficiency	Conf. limits \pm
Men	3.20	0.81	2.26	0.68	1.27 (1.68)	0.51 (0.59)
Women	1.45	0.45	3.49	0.69	0.86 (0.76)	0.35 (0.33)
All	2.15	0.42	2.99	0.50	1.02 (1.13)	0.29 (0.31)

Table V. The number (and percentages) of persons with a history of previous diseases and different symptoms that usually are considered to be related to a) venous insufficiency b) arterial insufficiency among the persons with ulcers and a) a venous component or b) an arterial component, compared with controls and chi-square values

a)	Low Varitest values and ulcers	Controls	Chi-square
Family occurrence*	40% (8/20)	8% (7/84)	$p = 0.00108$
Thrombosis*	39% (9/23)	4% (3/86)	$p < 0.00001$
Abdominal operations*	71% (12/21)	71% (61/86)	$p = 0.339$
Fractures*	5% (1/21)	11% (9/85)	$p = 0.688$
Varicose veins*	65% (15/23)	31% (27/86)	$p = 0.00654$
Operated Vv*	38% (9/23)	12% (10/86)	$p = 0.00546$
Pregnancies (women)	78% (7/9)	78% (25/32)	$p = 0.664$
Edema* +	70% (16/23)	17% (14/85)	$p < 0.00001$
Eczema ⁺	13% (3/23)	6% (5/86)	$p = 0.465$

b)	Low AI < 0.9 and ulcers	Controls	Chi-square
Myocardial infarction*	31% (4/13)	7% (6/86)	$p = 0.03081$
Angina pectoris*	46% (6/13)	13% (11/86)	$p = 0.00993$
Hypertension*	10% (1/10)	28% (24/86)	$p = 0.401$
Smokers*	42% (5/12)	14% (12/86)	$p = 0.04905$
Previous smokers*	17% (2/12)	43% (37/86)	$p = 0.152$
Diabetes*	42% (5/12)	11% (9/86)	$p = 0.01416$

* history of; + at examination

tion in an objective and non-invasive way, a computerised strain gauge plethysmographic apparatus (Varitest) has been used (7, 8), and for the arterial circulation systolic ankle and arm blood pressures (AI). An individual with low Varitest values was considered to have venous insufficiency, and arterial insufficiency was considered to be present if low ankle/arm pressure indices were found.

Eighty-two per cent (23/28) had low Varitest values among those with ulcers and can be considered to have a venous component as a cause of their ulcers. There were more persons (7/35) with leg ulcers than controls (4/86) and persons with other dermatoses (1/40) who were not able to participate in the test because of stiff ankle or knee joints. Limited ability to bend these joints usually correlates to decreased use of the venous pump and increased frequency of venous insufficiency and the number of persons with a venous component for their ulcers is probably therefore at least 82 per cent.

The peripheral arterial circulation was measured with sys-

tolic ankle/arm pressures. A normal ankle/arm index (AI) is considered to be 1.0 or above and the limit for arterial insufficiency is usually placed below 0.9 (6, 16, 17). An AI < 0.9 was present in 38 per cent of the individuals with leg and foot ulcers. Sometimes the limit AI < 0.85 for arterial insufficiency is used (18), or lower to be more certain that significant insufficiency is present. In our study, 21 per cent (7/34) of those with ulcers had AI < 0.7. At least 20 per cent and up to 38 per cent of ulcers therefore seem to have a significant arterial component as an ulcer cause.

Diabetes was found in 23 per cent of the persons with ulcers but only 6 per cent (2/35) had this as the only possible ulcer cause.

The ulcer site can be helpful in distinguishing between different types of ulcers. Most ulcers on the feet are caused by arterial insufficiency (19). In this study, the persons with ulcers and venous insufficiency did not have any ulcers on their feet, but foot ulcers were found among the persons with arterial

Table VI. The ulcer sites in 35 persons with leg ulcers related to Varitest values (Vv) and ankle/arm indices (AI) in the ulcerated legs. The ulcer site is called multiple if there is more than one ulcer on one leg or ulcers on both legs.

	Varitest values (Vv)			Ankle/arm indices (AI)			Vv and AI Low
	Low	Normal	Missing	Low	Normal	Missing	
Multiple	4	2	3	3	6	-	-
Medial	8	-	2	2	8	-	2
Foot	-	3	2	3	1	1	-
Lateral	5	-	-	4	1	-	4
Anterior	4	-	-	-	4	-	-
Posterior	2	-	-	1	1	-	1
All	23	5	7	13	21	1	7

insufficiency. It is often difficult to judge which factor is the most important cause of the leg or foot ulcer in persons with arterial and venous insufficiency and diabetes. Leg and foot ulcers are probably caused by several factors (3, 20, 21). Among our controls, there were many with venous and/or arterial insufficiency and/or diabetes and these individuals are probably at risk for developing ulcers, especially if exposed to trauma.

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