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CARDIOVASCULAR DISEASES

Lifestyle risk factors for lower limb venous reflux in the general population: Edinburgh Vein Study

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Background Varicose veins occur commonly in the general population but the aetiology is not well established. Varicosities are associated frequently with reflux of blood in the leg veins due to valvular incompetence. Our aim was to determine in the general population which lifestyle factors were related to reflux and thus implicated in the aetiology of varicose veins.

Methods In the Edinburgh Vein Study, 1566 men and women aged 18–64 years were sampled randomly from the general population in the city of Edinburgh, Scotland, and had duplex scans to measure reflux in eight venous segments in each leg. A self-administered questionnaire enquired about occupation, mobility at work, smoking, obstetric history, dietary fibre intake and bowel habit. A bowel record form was completed subsequently.

Results In women, venous reflux was associated with decreased sitting at work (odds ratio [OR] = 0.76, 95% CI : 0.61–0.94), previous pregnancy (OR = 1.20, 95% CI : 0.93–1.54), and a lower prior use of oral contraceptives (OR = 0.84, 95% CI : 0.66–1.06). Mean body mass index was greater in women with superficial reflux compared to those with no reflux: 26.2 kg/m^2 (95% CI : 25.5–27.0) versus 25.2 kg/m^2 (95% CI : 24.8–25.6). On age adjustment, sitting at work remained related to reflux (OR = 0.78, 95% CI : 0.63–0.98) and prior use of oral contraceptives to superficial reflux (OR = 0.71, 95% CI : 0.50–1.01). In age-adjusted analyses in men, height was related to reflux, (OR = 1.13, 95% CI : 1.02–1.26) and straining at stool was related to superficial reflux (OR = 1.94, 95% CI : 1.12–3.35). No associations were found in either sex between reflux and social class, lifetime cigarette consumption, dietary fibre intake and intestinal transit time.

Conclusions This population study did not identify strong and consistent lifestyle risk factors for venous reflux although previous pregnancy, lower use of oral contraceptives, obesity and mobility at work in women and height and straining at stool in men may be implicated.

Keywords Venous disease, legs, duplex ultrasound, diet, obesity, bowel habit, pregnancy, oral contraceptive

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Varicose veins affect around one-quarter of the adult population in western countries[1–3] causing considerable morbidity and use of health service resources.[4] The aetiology of the condition remains obscure. In the 1970s Burkitt,[5] Cleave[6] and others postulated that a western lifestyle comprising features such as a low fibre, highly refined diet, standing at work, sitting in chairs, toilet posture and tight undergarments increased the risk of varicosities compared to those living in developing countries. Such hypotheses have not been proven. Likewise, the widely held view that obesity and parity are risk factors for varicose veins

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has not been shown consistently in epidemiological studies,[1–3] nor has genetic inheritance been demonstrated.

In studying the aetiology of varicose veins, one of the difficulties is the lack of clarity and consistency in defining, classifying and grading the severity of varicose veins. Furthermore, the presence of clinical disease may lead to selection bias in subjects entering studies and to a change in lifestyle, so that association with a factor may be a consequence rather than a cause of disease. These difficulties can, however, be reduced by studying venous reflux as the endpoint. Reflux consists of retrograde flow of blood in a segment of vein due to malfunction or, rarely, disease of a venous valve and is associated with the presence of varicose veins.[7] Duplex ultrasound scanning is a valid and reproducible method of measuring reflux[8,9] and produces a more objective measure of venous abnormality than the assessment of varicosities by clinical observation.

A major aim of the Edinburgh Vein Study was for the first time to determine the relationship between possible venous risk factors and venous reflux measured by duplex scanning in the adult general population. The risk factors assessed were those that have been investigated in studies of varicose veins[1–3] and comprised dietary fibre intake, bowel habit, obesity, parity, use of contraceptive pill and hormone replacement therapy, mobility at work and cigarette smoking.

Methods

The Edinburgh Vein Study is a cross-sectional survey of men and women aged 18–64 years resident in Edinburgh, Scotland. An age-stratified random sample was selected from the computerized age-sex registers of 12 general practices with catchment areas geographically and socioeconomically distributed throughout the city. We estimated that a total sample size of 1500 participants was needed to detect a significant difference in prevalence of venous disease between groups and to enable a subsequent follow-up study to be conducted.

Equal numbers of men and women were invited to participate in the study. Of 2912 people contacted, 1566 participated giving a response rate of 53.8%. The response rate increased with age and was slightly higher in women than men. Overall, the ethnic origin and social class of participants were similar to those of the general Edinburgh population except that a slightly higher proportion of participants were from the upper socioeconomic groups (social class I 10.8% versus 8.5%; class II 37.0% versus 30.4%). Details of the methods and response rate have been reported.[10] Local ethics committee approval for the study was granted and informed consent was obtained from each participant.

Subjects attended a clinic in the University of Edinburgh between May 1994 and April 1996 and were examined by one or more members of a research team, comprising a nurse, technician and clinical research fellow. A self-administered questionnaire was completed which included questions about occupation, smoking, bowel habit, and obstetric history (for women). Mobility at work was assessed by visual analogue scales of time spent sitting, standing, walking and heavy lifting with each scale ranging from 'never' to 'all the time'. A dietary fibre questionnaire was completed (Tinuviel Software, Warrington, UK) which was adapted from a validated Medical Research Council (MRC) fibre questionnaire.[11] Modifications to the original MRC questionnaire included the replacement of any quantitative estimates of portion size (usually in tablespoons) with sex-specific standard portion sizes and updating the questions about vegetables and breakfast cereals to include additional types. From this modified dietary questionnaire, weekly intake of cereal and vegetable fibre was assessed. Social class was coded for each individual according to the Standard Occupational Classification.[12] Subjects had their standing height measured to the nearest 5 mm without shoes using a free-standing metal rule on a heavy base. Weight, without shoes or outdoor clothes, was measured to the nearest 100 g on a digital Soehnle scale. The presence of varicose veins was assessed by means of a standardized examination in which the subject stood on a raised platform for a minimum of 2 minutes before classification by a trained observer.[10]

Duplex scans were performed with a Diasonics Prisma VST duplex scanner (Diasonics Sonotron, Zug, Switzerland) using a 5.0 MHz linear array probe. Each subject was examined on a tilting couch at an angle of 45°. Cephalad venous flow was induced using a pneumatic cuff around the calf attached to an automatic cuff inflator (Oak Medical, Scunthorpe, UK). Measurements were made in the following eight vein segments in both legs: common femoral vein (CFV) proximal to the saphenofemoral junction; superficial femoral vein (1) approximately 2 cm distal to the confluence with the profunda femoris vein (upper SFV) and (2) in the lower third of the thigh (lower SFV); popliteal vein (1) above the knee crease (above knee popliteal) and (2) below the knee crease (below knee popliteal); long saphenous vein (1) just distal to the sapheno-femoral junction (upper LSV) and (2) in the lower third of the thigh (lower thigh LSV); short saphenous vein just distal to the sapheno-popliteal junction (SSV). In addition, the presence of any dual superficial femoral veins was documented and measurement of duration of reflux in these veins performed.

When cephalad venous flow was induced in the limb under examination, any reflux present was identified on the Doppler spectrum. Two typical spectra were selected at each site and the duration of reflux was measured by placing the cursors at the beginning and end of the period of reflux. The mean of the two readings at each point on the vein was used in all subsequent analysis. A reflux duration of $\geqslant 0.5$ seconds was used to define pathological reflux. (Minor reflux of <0.5 seconds may occur normally due to the time required for valve closure.) Quality control measures included (1) repeat scans by a radiologist (PLA) if doubtful results were obtained and (2) periodically sequential duplex scans by all three observers on the same subjects to allow inter-observer comparison of results. Further details on the methods of duplex scanning have been reported.[13]

Following attendance at the clinic, each subject was requested to complete a bowel record form, which documented the date, time and consistency of three consecutive stools. The average number of defecations per week was obtained from responses to questions in the general questionnaire and, with the information from the bowel record form, the subject's intestinal transit time was estimated according to the method described by Probert *et al.*[14]

All data were entered onto a computer database and transferred to the University of Edinburgh mainframe computer for statistical analysis using SPSS-X and SAS. All subjects were included in the analysis; the presumed small number of subjects

with factors which might have affected venous function, such as presence of heart failure and consumption of 'venotonic' drugs, were not excluded. The χ^2 test and Mantel-Haenszel test for linear trend were used for categorical data and the students t-test for continuous parametric data. Due to extreme skewness, dietary fibre and intestinal transit time were log transformed prior to analysis and pack-years (average packs of 20 cigarettes smoked per day × years of smoking) was square root transformed. PROC GENMOD in SAS was used to fit generalized linear models to obtain the risk of significant reflux for each risk factor. The odds ratios (OR) were then adjusted for age and for each of the other risk factors simultaneously.

Results

Among the 1566 participants in the Edinburgh Vein Study, 218 did not have a satisfactory measure of reflux in two or more venous segments in either leg and were excluded from the analysis. These missing values were due to prior surgical removal of a vein segment or absence of measurable blood flow. Also, some participants were unable to undergo all or part of the scan because of a pre-existing medical condition, feeling faint, or the clinical examination being performed in their home. In the remaining 1348 subjects (739 women and 609 men), 658 had reflux ⩾0.5 seconds in at least one segment and 690 had no reflux. The number of segments affected was similar in women and men and less than 15% had reflux in four or more segments (Table 1). The pattern of reflux, which we reported in detail previously,[13] differed between the sexes: reflux of the superficial veins in the leg was more common in women than men ($P = 0.002$) and reflux of the deep veins within the leg was more common in men than women ($P = 0.001$) (Table 1). In those with deep reflux alone (n = 325), only 43 had reflux limited to the common femoral vein.

Subjects with reflux in one or more segments compared to those with no reflux were more likely to be male, 48.6% (95% CI : 44.7–52.4) versus 41.9% (95% CI : 38.2–45.7), and had a higher mean age, 46.6 years (95% CI : 45.6–47.6) versus 43.1 years (95% CI : 42.1–44.1). There was no difference in social class between those with and without reflux, non-manual I-IIIN 72.1% (95% CI : 68.2–75.7) versus 73.8% (95% CI : 70.1–77.3); manual IIIM-V 27.9% (95% CI : 24.3–31.8) versus 26.1% (95% CI : 22.7–29.9). The distribution of several possible risk factors and the OR for venous reflux are shown in Table 2 for women and in Table 3 for men. Among women, the risk of having reflux was lower among those who reported sitting at work for more than half their working day (OR = 0.75, 95% CI : 0.57–0.99) independently of other possible risk factors. There

Table 1 Number and pattern of venous segments with reflux ⩾0.5 seconds in either leg in women and men in the Edinburgh Vein Study

	Percentage	
	Women	Men
No. of segments with reflux	(n = 739)	(n = 609)
None	54.4	47.3
1	16.4	16.3
2	12.6	13.5
3	4.6	7.1
4+	12.0	15.9
Pattern of reflux[a]	(n = 722)	(n = 596)
Superficial only	24.1	17.3
Deep only	17.6	32.4
Combined	11.8	12.1

[a] All subjects who had previous varicose vein surgery were excluded because of missing values predominantly in the superficial group.

Superficial reflux: one or more of long or short saphenous veins affected with common femoral, superficial femoral and popliteal all unaffected.

Deep reflux: one or more of common femoral, superficial femoral and popliteal affected with long and short saphenous veins both unaffected.

Combined: one or more of long or short saphenous *and* common femoral, superficial femoral or popliteal affected.

Table 2 Risk factors in women in relation to presence of reflux (⩾0.5 seconds) in any venous segment in either leg

	No reflux (n = 398)	Reflux (n = 341)	Unadjusted OR[a]	Age-adjusted OR	Multi-adjusted OR
Mobility at work (score ⩾5 in range of 1–8)					
Sitting (%)	51.3 (46.2–56.3)	38.8 (33.6–44.2)	0.76 (0.61–0.94)	0.78 (0.63–0.98)	0.75 (0.57–0.99)
Standing (%)	27.3 (22.9–31.9)	30.5 (25.7–35.7)	1.09 (0.86–1.37)	1.09 (0.87–1.38)	1.01 (0.76–1.34)
Walking (%)	27.1 (22.8–31.8)	29.0 (24.3–34.2)	1.05 (0.83–1.33)	1.02 (0.81–1.30)	0.88 (0.65–1.18)
Heavy lifting (%)	10.6 (7.7–14.0)	11.2 (8.1–15.1)	1.05 (0.75–1.47)	1.05 (0.75–1.48)	1.02 (1.45–1.54)
Gastrointestinal habit					
Dietary fibre (g/week[b])	128.2 (122.6–134.1)	132.6 (126.7–138.9)	1.12 (0.88–1.43)	1.08 (0.85–1.38)	1.08 (0.81–1.44)
Intestinal transit time (hours[b])	56.5 (54.4–58.6)	57.9 (55.3–60.5)	1.15 (0.85–1.55)	1.13 (0.84–1.54)	1.17 (0.84–1.63)
Straining (%)	17.8 (14.2–22.0)	19.4 (15.3–24.0)	1.05 (0.80–1.38)	0.97 (0.74–1.28)	0.99 (0.73–1.36)
Reproductive history					
Pregnancy: ever (%)	68.4 (63.5–73.0)	75.0 (69.9–79.6)	1.20 (0.93–1.54)	1.00 (0.76–1.31)	0.96 (0.71–1.29)
Oral contraceptive: ever (%)	78.0 (73.6–82.0)	71.6 (66.4–76.3)	0.84 (0.66–1.06)	0.98 (0.75–1.27)	0.93 (0.69–1.24)
Hormone replacement therapy: ever (%)	14.8 (11.4–18.7)	19.7 (15.6–24.4)	1.17 (0.89–1.53)	1.01 (0.76–1.35)	1.03 (0.76–1.43)
Cigarette pack-years (√)	1.6 (1.4–1.8)	1.6 (1.4–1.8)	1.01 (0.91–1.13)	0.97 (0.87–1.08)	0.99 (0.88–1.12)
Body mass index (kg/m^2)	25.2 (24.8–25.6)	25.8 (25.2–26.4)	1.06 (0.96–1.17)	1.01 (0.91–1.13)	1.05 (0.93–1.19)
Height (m)	1.62 (1.61–1.63)	1.62 (1.61–1.63)	1.03 (0.93–1.14)	1.09 (0.98–1.21)	1.09 (0.97–1.23)

[a] Odds ratio.

Figures are %, mean, [b] geometric mean, or OR, each with (95% CI).

Table 3 Risk factors in men in relation to presence of reflux (≥0.5 seconds) in any venous segment in either leg

	No reflux (n = 287)	Reflux (n = 322)	Unadjusted OR[a]	Age-adjusted OR	Multi-adjusted OR
Mobility at work (score ≥5 in range of 1–8)					
Sitting (%)	42.0 (36.2–47.9)	48.0 (42.4–53.6)	1.11 (0.89–1.39)	1.14 (0.91–1.42)	1.09 (0.83–1.43)
Standing (%)	31.0 (25.7–36.7)	29.9 (24.9–35.2)	0.98 (0.77–1.24)	0.97 (0.76–1.23)	1.04 (0.77–1.40)
Walking (%)	29.7 (24.5–35.4)	25.9 (21.2–31.0)	0.92 (0.71–1.18)	0.90 (0.70–1.16)	0.93 (0.68–1.27)
Heavy lifting (%)	21.0 (16.4–26.2)	16.9 (12.9–21.4)	0.88 (0.66–1.18)	0.88 (0.65–1.17)	0.96 (0.68–1.38)
Gastrointestinal habit					
Dietary fibre (g/week[b])	147.0 (139.9–154.5)	151.6 (144.3–159.2)	1.08 (0.84–1.38)	1.08 (0.84–1.38)	1.06 (0.81–1.38)
Intestinal transit time (hours[b])	52.4 (51.0–53.8)	52.9 (51.6–52.2)	1.08 (0.63–1.85)	1.07 (0.63–1.84)	1.07 (0.61–1.88)
Straining (%)	6.3 (3.8–9.7)	10.3 (7.2–14.1)	1.25 (0.88–1.80)	0.80 (0.56–1.15)	0.84 (0.56–1.26)
Cigarette pack-years (√)	2.1 (1.9–2.3)	2.2 (1.8–2.6)	1.03 (0.92–1.15)	1.00 (0.89–1.12)	1.03 (0.90–1.17)
Body mass index (kg/m^2)	25.8 (25.4–26.2)	25.8 (25.4–26.2)	1.01 (0.90–1.12)	0.98 (0.88–1.10)	0.99 (0.87–1.13)
Height (m)	1.74 (1.73–1.75)	1.76 (1.75–1.77)	1.11 (1.00–1.23)	1.13 (1.02–1.26)	1.11 (0.98–1.25)

[a] Odds ratio.

Figures are %, mean, [b] geometric mean, or odds ratio, each with (95% CI).

was, however, no difference in the amount of standing, walking or heavy lifting between those women with and without reflux. In men, no differences in these measures of mobility at work were found between those with and without reflux. Women who had been pregnant were more likely to have reflux (OR = 1.20, 95% CI : 0.93–1.54) but this association was reduced on age adjustment (OR = 1.00, 95% CI : 0.76–1.31). A history of oral contraceptive use was associated with less reflux (OR = 0.84, 95% CI : 0.66–1.06), although this was also reduced on age adjustment (OR = 0.98, 95% CI : 0.75–1.27). In both sexes, no relationship was found between risk of reflux and each of dietary fibre intake, intestinal transit time, straining at stool, and lifetime pack-years of cigarette smoking (Tables 2 and 3). Body mass index was unrelated to reflux in either sex, but height was associated with a slightly increased risk of reflux in men (age-adjusted OR = 1.13, 95% CI : 1.02–1.26).

The distribution of those risk factors shown in Tables 2 and 3 were also examined for trends according to number of venous segments affected by reflux (data not shown). In women, less sitting and more standing at work were associated with greater number of segments affected by reflux, but these trends were not statistically significant ($P = 0.07$ and $P = 0.09$, respectively). The main finding was that in men and women combined, body mass index was significantly higher in those with multiple affected segments (≥4) compared to those with a few affected segments (1–3) or no reflux (P for trend ≤0.02).

The relationships between the potential risk factors and reflux were then examined separately for superficial, deep and combined reflux because these patterns of reflux are differentiated clinically and the risk factors might have had a varying effect. Women with either superficial or deep reflux were found to spend less time sitting at work compared to those without the respective reflux, but the differences were not statistically significant, superficial: 42.0% (95% CI : 34.5–49.7%) versus 47.0% (95% CI : 42.7–51.3%) with high sitting score ($P = 0.25$) and deep: 38.9% (95% CI : 30.3–48.0%) versus 47.2% (95% CI : 43.2–51.3%) with high sitting score ($P = 0.09$). In men, straining at stool was associated with an increased risk of superficial reflux (age-adjusted OR = 1.94, 95% CI : 1.12–3.35).

Table 4 shows that oral contraceptive use was lower among women with superficial reflux. The age-adjusted OR of the contraceptive pill (ever versus never) for superficial reflux was 0.71 (95% CI : 0.50–1.01). On further adjustment for number of pregnancies, the OR did not change, 0.71 (95% CI : 0.49–1.03). The lower frequency of oral contraceptive use in women with superficial reflux compared to those without reflux was observed in both those with trunk varices (60.2% versus 67.8%) and in those with no trunk varices (66.7% versus 81.4%), although these differences were not statistically significant ($P > 0.05$). Table 4 also shows that body mass index was higher in women with superficial reflux, but not in women with deep reflux. The

Table 4 Reproductive history and obesity in women with and without superficial or deep venous reflux (≥0.5 seconds) only in either leg

	Superficial reflux		Deep reflux	
	None (n = 548)	Present (n = 174)	None (n = 595)	Present (n = 127)
Reproductive history				
Pregnancy: ever (%)	70.0 (65.9–73.9)	75.5 (68.2–81.8)	71.5 (67.6–75.1)	70.5 (61.6–78.4)
Oral contraceptive: ever (%)	79.1 (75.5–82.5)	62.6 (54.9–69.8)	74.2 (70.4–77.7)	79.7 (71.5–86.4)
Hormone replacement therapy: ever (%)	15.4 (12.4–18.7)	21.1 (15.2–27.9)	17.0 (14.1–20.3)	15.4 (9.6–23.1)
Obesity				
Body mass index (kg/m^2)	25.2 (24.8–25.6)	26.2 (25.5–27.0)	25.6 (25.2–26.0)	24.9 (24.1–25.7)

Figures are column % or mean (95% CI).

risk of superficial reflux for unit increase in body mass index after age adjustment was OR = 1.08 (95% CI : 0.93–1.24).

Discussion

This is the first study to report on the relationship between potential risk factors and venous reflux measured by duplex scanning in the general population. We found that in women the presence of reflux was related univariately to a decreased amount of sitting at work, previous pregnancy, and less oral contraceptive use. Obesity was associated with superficial and not deep reflux. However, on adjusting for age, only the relationships between sitting at work and reflux and oral contraceptive use and superficial reflux remained significant. In men, height was related to reflux and straining at stool to superficial reflux. No associations were found in either sex between reflux and social class, lifetime cigarette consumption, dietary fibre intake and intestinal transit time.

The Edinburgh Vein Study is a cross-sectional survey and the possibility of bias needs to be considered. Although the response rate was only 54%, we found that the study sample was reasonably typical in terms of the social class of the general population in Edinburgh[10] and was unlikely to differ greatly from the target population in the risk factors studied. Our study, however, had the advantage over many previous studies which, although achieving higher response rates, were carried out on selected groups based, for example, on occupation, and were inherently biased. In the analysis of reflux, 14% of subjects had to be excluded because of missing values but this group were no different from those included in age, sex, social class or body mass index (data not shown). The extent of reflux may, however, have been underestimated in the population as a whole because for practical reasons we did not assess the calf veins. Although 0.5 seconds is accepted as a reasonable cut-off point for identifying abnormal reflux, it may have misclassified some subjects with normally functioning valves. The consequence would be to diminish the strength of association with risk factors, although we did find in a previous analysis that taking a cut-off point of 1.0 seconds had minimal effect in classifying the presence of reflux in the superficial veins.[13] The endpoint of reflux has the advantage of being an objective non-clinical measure and there was less potential for recall bias by subjects in assessing the presence of risk factors than in those with overt clinical disease. However, we have shown in the Edinburgh Vein Study that venous reflux, leg symptoms and the presence of varicosities may be inter-related,[15–17] but when we investigated the relationship between risk factors and reflux, bias due to the presence or absence of varicosities was not observed. Thus, although bias in our results cannot be ruled out, there is no evidence to indicate that any of the results should be discounted. However, interpretation of the results must be made with caution because of the problem of multiple testing even although the analyses were based on sound pre-determined hypotheses.

The occurrence of varicose veins in the general population has been shown in other community studies to be associated, especially in women, with prolonged standing at work[18,19] and greater duration of sedentary activity during the day.[20] In the Edinburgh Vein Study, the prevalence of trunk varices in women was related to more standing and less sitting at work[21] but, in examining reflux, we found that reflux appeared to be related predominantly to less sitting. This would suggest that valvular reflux may be avoided by following a more sedentary lifestyle. However, the results from the Edinburgh Vein Study and other surveys must be interpreted with caution because they are based solely on questionnaire responses and none have assessed mobility at work directly nor measured total lifetime mobility. Furthermore, other factors such as obesity may confound such relationships, although multivariate adjustment in our study did not have a major impact on the univariate results.

In previous population surveys, the prevalence of varicose veins has been related to a history of pregnancy[18,22] or number of pregnancies[19,22–24] but such relationships have not been found universally.[20,25] There is very little evidence of an effect independent of age[19] and so, although it appears that during pregnancy varicose veins may occur, albeit often temporarily, the effect of pregnancy on long-term risk is not clear. Our findings on venous reflux were comparable to that for varicose veins in that an association with previous pregnancy was not maintained after adjustment for age. Likewise, any link between venous disease and oral contraceptive use has not been proven. No association was observed between trunk varices and oral contraceptive use in the Mini-Finland Health survey,[19] the Basle Study of pharmaceutical workers[26] or a community study in London.[23] In our study, superficial venous reflux was related to a lower frequency of oral contraceptive use, independently of age. This relationship did not appear to be due to less prescribing of contraceptives in those with venous disease because the reduction in contraceptive use occurred in both those with and without trunk varices, albeit non-significantly. Also, the relationship was not confounded by number of pregnancies. However, the overall findings in our study do not suggest that reproductive factors are strongly related to the risk of venous disease, independently of age. Nevertheless, this does not rule out a possible role for these factors in aetiology.

The finding that obesity was related to superficial reflux only in women is in accord with findings in population-based studies of varicose veins. In Jerusalem, people with varicose veins had a higher body mass index than normal, but on multivariate adjustment the relationship remained significant only in women.[18] Similarly among European New Zealanders body mass index was related to severity of varicose veins only in women and independently of parity.[27] In longitudinal studies in Framingham and the Netherlands, overweight at baseline was associated with a higher incidence of varicose veins only in women.[20,28] Thus, there is good population-based evidence, particularly in women, that greater body mass is related to increased risk of varicose veins. It is not clear, however, whether the risk increases above a certain cut-off point or is apparent across the range of body mass index. A pathogenic mechanism has not been demonstrated but might consist of increased intra-abdominal pressure reducing blood flow in the pelvic veins.

In attempting to explain an apparently higher prevalence of varicose veins in western compared to developing countries, various hypotheses were put forward concerning the untoward effects of a low fibre diet resulting in constipation, straining at stool and high venous pressure.[5,6] Very few population-based studies have examined diet and constipation in individuals with varicose veins and most are of limited value because of

measurement difficulties and confounding factors. In a subsample of the Paris Prospective Study no difference was found in the consumption of fruit and vegetables between men with and without varicose veins.[29] Reported constipation was slightly more common in subjects with varicose veins in population surveys in Sicily[22] and in Jerusalem[18] (only in women) compared to the normal population. In the Edinburgh Vein Study we have examined dietary fibre and constipation in more detail than in previous studies and have used previously validated methods.[11,14] We found that a lower fibre intake, longer intestinal transit time, and straining at stool were associated with an increased risk of severe trunk varices in men only.[30] However, only straining was shown in the present analysis to be related to venous reflux. This suggests that straining could be the main aetiological mechanism rather than any other effects of constipation such as compression of the iliac veins.[6] The lack of an effect in women may be due to differences in degree of straining between the sexes or that other factors are more predominant. The evidence relating dietary fibre, constipation and straining to venous disease within western populations is currently so limited that no conclusions can be drawn about the importance of these factors in aetiology.

The pathogenesis of incompetence of venous valves is not well established but is believed to be due to weakness and dilatation of the vein wall and/or weakness of the valve cusps.[31] These changes could conceivably be caused by an abnormally high venous pressure due to obstruction or increased blood volume. Alternatively, hormonal changes or genetic differences might lead to changes in the composition of the vein wall, for example in collagen, elastin or smooth muscle content.[32,33] Of the risk factors we have found to be related to reflux, mobility at work, height and straining at stool are likely to be pressure effects, whereas reproductive factors may have hormonal and blood volume effects. The pressure effects of pregnancy may have long-term consequences but are thought not to increase the risk of varicose veins during pregnancy which tends to occur in the first trimester.[34] Thus, there are plausible mechanisms, albeit tenuous, mediating the risk factors we have found to be associated with reflux.

Overall, however, the evidence indicating that these factors have an independent effect on the risk of venous disease in the general population is not strong or consistent, and the aetiology remains obscure. Further research is required examining these lifestyle factors as well as pursuing the very limited[35] and generally anecdotal evidence of familial inheritance. Such research should investigate, as we have done, the relationships with objective measures of venous reflux as well as observations of clinical disease.

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