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Age-related differences in invasive treatment of peripheral arterial disease: Disease severity versus social support as determinants

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Abstract

Objective: Social support may influence the seeking of appropriate treatment. We examined social support and peripheral arterial disease (PAD) severity as determinants of treatment for PAD in younger and older patients. **Methods:** Consecutive PAD patients ($N=203$) completed the Perceived Social Support Scale. Treadmill-walking distance and ankle-brachial pressure index (ABPI) were measured. The main outcome was invasive treatment for PAD in the year following diagnosis. **Results:** During follow-up, 48% of the patients underwent invasive treatment for PAD.

Younger patients (≤ 64 years) tended to be more often invasively treated as compared to older patients. In younger patients, a high level of social support predicted invasive treatment above and beyond PAD severity. In older patients, low ABPI predicted invasive treatment. **Conclusion:** Younger patients with inadequate social support may fail to seek appropriate treatment, suggesting the need to consider psychosocial factors in optimizing treatment of atherosclerotic vascular disease in this high-risk group.

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Keywords: Peripheral arterial disease; Ankle-brachial index; Social support; Invasive treatment; Age; Prognosis

Introduction

Peripheral arterial disease (PAD) is a marker of systemic atherosclerosis and is associated with an increased risk of stroke, myocardial infarction, and cardiovascular death [1,2] as well as cardiovascular risk factors such as smoking, diabetes, hypertension, and hyperlipidemia. Previous studies have shown that 95% of PAD patients have at least one of these risk factors [2]. Intermittent claudication, a common symptom of PAD, can lead to impaired walking ability [3,4] and poor quality of life [5]. Despite its deleterious effects, PAD remains a relatively underdiagnosed and untreated disease [6].

Both disease severity and patient-based characteristics such as age influence treatment of PAD [7]. In younger

patients, lifestyle or occupational performance can be strongly affected by the presence of PAD [8,9]. Therefore, it has been argued that invasive treatment is most suitable for these patients [10]. Age has also been associated with prognosis and hospital course in other cardiovascular patient groups [11,12]. Elderly patients often have longer hospital stays and poorer prognosis as compared with younger patients [11].

Perceived social support may also influence the clinical treatment of cardiovascular disease. Perceived social support denotes the appraisal and the evaluation of existing social relationships [13], and the perception that support would be available if needed [14]. It has been shown that adequate functional support influences adherence to treatment [15]. Social support may facilitate the process of receiving medical care by stimulating patients to engage in more healthy behaviours [16–18]. In cardiac patients, inadequate functional support, such as low perceived social support, has been associated with adverse clinical outcomes and mortality [14,19]. In patients with carotid artery

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stenosis, lack of social support was associated with aversion to invasive treatment of their condition [16]. Social isolation is associated with cardiovascular events in cardiac patients [20,21] and a lower ankle-brachial pressure index (ABPI) in PAD patients [22].

Despite these findings, the role of social support in PAD is largely unknown. Therefore, the aim of the present study was to examine the relative effect of disease severity and social support as determinants of invasive treatment in younger and older patients in the year following diagnosis. We hypothesized that higher levels of perceived social support are associated with a greater likelihood of getting invasive treatment in PAD patients.

Method

Patients

Between September 2001 and March 2004, a total of 257 consecutive patients presenting with symptomatic PAD were admitted to the vascular outpatient clinic of the department of surgery at the St. Elisabeth Hospital in Tilburg, the Netherlands. All patients were newly diagnosed with PAD, based on history, physical examination, treadmill-walking distance, and ABPI. Six patients were excluded from the study due to cognitive impairment (2 patients), recent myocardial infarction, visual problems, illness (flu), and participation in another study. Of the remaining 251 patients, 203 (81%) agreed to participate. No significant differences were found in age, sex, ABPI, maximum walking distance (MWD), pain-free walking distance (PFWD), cardiovascular risk factors, or comorbidity between participants and nonparticipants. The study was approved by the local ethics committee, and all patients signed written, informed consent.

Predictors

Disease severity

In all patients, the PFWD, MWD, and ABPI were measured as indices of severity of PAD. The ABPI is defined as the ratio of the ankle systolic blood pressure to the brachial artery systolic blood pressure and has a normal resting value of about 1.0 [3]. A value of <0.90 is 95% sensitive to detect PAD [6,7] and has been shown to be a strong predictor of cardiovascular disease and mortality [23].

Treadmill-walking tests were performed to determine PFWD and MWD. Treadmill tests are widely used to obtain objective information on walking ability of patients with symptomatic PAD [24]. During the treadmill test, patients had to walk 3.5 km/h on a 5% incline, with a maximum of 1000 m [25]. For diagnosis, the exercise had to provoke the typical pain and show an ABPI drop of at least 20 mmHg on the symptomatic leg side [26].

Although the APBI is a sensitive measure of PAD severity, it does not correlate well with functional limitation measures such as PFWD and MWD in PAD patients [7]. Therefore, in the present study both the ABPI and the indexes of walking distance were used to measure disease severity.

Cardiovascular risk factors

In the present study, diabetes mellitus, smoking, hypertension, hyperlipidemia, and cardiac, carotid, renal, and pulmonary status were measured at baseline in all patients according to the standards recommended by the Society for Vascular Surgery/North American Chapter of the International Society for Cardiovascular Surgery (Appendix A) [26].

Social support

To assess perceived social support, the 12-item version of the Perceived Social Support Scale-Revised [27] was used. This self-report scale examines perceived availability of social relationships and satisfaction with social support [19]. A total score and three subscale scores addressing social support from family, friends, and significant others can be obtained [27]. Item examples are the following: “I get the emotional help and support I need from my family” and “My friends really try to help me.” The item’s rating scale varied from 1 (*very strongly disagree*) to 7 (*very strongly agree*). In cardiac patients, reliability and validity were good [27]. In the present study, the Cronbach’s alpha coefficient was .92 for the total score, and .89, .96, and .95 for the subscales support from partner, family, and friends, respectively.

Invasive treatment of PAD

Invasive treatment of PAD, either endovascular or surgical, was used as an endpoint in the present study. The general treatment policy for patients with intermittent claudication is merely conservative, i.e., unsupervised exercise training, the advice to quit smoking, and anti-platelet medication, which is prescribed all patients. However, this does not always lead to improvements in walking distance. Invasive therapy is then considered. However, in case of severe impairment, or when conservative treatment is not expected to improve patient’s functioning, invasive treatment is considered sooner, especially in younger patients with more demanding lifestyles. During the 1-year follow-up period, hospital admission was prospectively examined using the patient records from the participating hospital. All patients who underwent invasive treatment were hospitalized. Invasive procedures were carried out in the St. Elisabeth Hospital. In case a patient would have been admitted to another hospital, or abroad, this information would be obtained from the patient records of the St. Elisabeth Hospital. Patients who were not

hospitalized at all during the 1-year follow-up period were considered event free. Patients were excluded from further analyses if they were hospitalized for other reasons than invasive treatment of PAD, such as coronary artery bypass grafting, or died during follow-up. All patients were followed up throughout the study period with regard to hospital admission.

Statistical analyses

Chi-square tests (dichotomous variables) were used to examine differences between patient groups. Logistic regression analyses were used to examine the predictive value of ABPI, PFWD, MWD, and cardiovascular risk factors separately with regard to invasive treatment for PAD, after controlling for age and sex. Therefore, ABPI, PFWD, and MWD were dichotomized into low scores (first quartile) vs. average or high scores. This led to a cutoff score of 0.51 for ABPI, and cutoff scores of 40 and 130 m for limited PFWD and MWD, respectively. These cutoff scores are in accordance with a previous study [28]. The cardiovascular risk factors were dichotomized to absent or present. The total score of the Perceived Social Support Scale was dichotomized into high scores (high levels of social support; upper tertile; cutoff score >67) vs. average or low scores. PFWD and MWD were included in a logistic regression analysis (forward conditional method) to determine which treadmill walking distance measure was the best predictor of invasive treatment. To examine whether the predictive values of disease severity indices regarding invasive treatment were age dependent, the interaction terms Age \times ABPI, and Age \times Treadmill Walking Distance (either PFWD or MWD) were analyzed. To examine the effect of high levels of perceived social support in younger and older patients separately, we included age, sex, ABPI, treadmill walking distance, cardiovascular risk factors, and the Perceived Social Support Scale score in multivariate logistic regression analyses (enter method) with invasive treatment as the endpoint. Conservatively treated patients were used as the reference group. All statistical analyses were performed with the Statistical Package for the Social Sciences (SPSS) version 12.0 (SPSS Inc, Chicago, IL).

Results

Of all symptomatic PAD patients, the majority ($n=186$; 92%) reported the classical symptoms of intermittent claudication, such as cramping or painful aching in the legs that starts after a certain walking distance and resolves within a few minutes after the patient stops walking [9]. A small group ($n=17$; 8%) reported atypical leg symptoms. The mean age of the study sample was 64.5 years, and the majority were men (63%) (Table 1). During the follow-up period, 4 (2%) patients had died and were therefore excluded from the study. Seven patients who were

Table 1
Baseline characteristics of the 203 patients who agreed to participate in the study

	Total patient sample ($N=203$)	Younger patients ($n=99$)	Older patients ($n=104$)
Age (years), mean \pm S.D.	64.5 \pm 10	55.9 \pm 5.6	72.6 \pm 5.4
Male sex	127 (63%)	72%	54%
Mean ankle-brachial pressure index \pm S.D.	0.62 \pm 0.16	0.65 \pm 0.15	0.59 \pm 0.16
PFWD (m), mean \pm S.D.	113.6 \pm 141	121.6 \pm 124	105.8 \pm 156
MWD (m), mean \pm S.D.	372.8 \pm 322	431.8 \pm 330	314.5 \pm 304
Diabetes mellitus	39 (19%)	14%	24%
Tobacco use	111 (55%)	67%	43%
Hypertension	91 (45%)	33%	56%
Hyperlipidemia	105 (52%)	57%	47%
Cardiac status	61 (30%)	24%	36%
Carotid status	20 (10%)	10%	10%
Renal status	8 (4%)	1%	6%
Pulmonary status	17 (8%)	3%	14%

hospitalized for other reasons than invasive treatment of PAD were also excluded, leaving 192 patients for further analyses. After 1 year, 99 (52%) patients had received conservative treatment, whereas 93 patients were treated invasively for their PAD condition. Modes of invasive treatment were percutaneous transluminal angioplasty (PTA; 58%), bypass surgery (11%), desobstruction (5%), endarterectomy (2%), or combinations of these interventions (24%).

Disease severity and invasive treatment

Low ABPI was associated with invasive treatment during follow-up [odds ratio (OR), 2.32; 95% confidence interval (CI), 1.13–4.78; $P=.022$] after controlling for age and sex. Limited PFWD (OR, 2.61; 95%CI, 1.28–5.30; $P=.008$) and MWD (OR, 6.17; 95% CI, 2.70–14.07; $P<.0001$) were also associated with invasive treatment, controlling for age and sex. Invasively treated patients had a shorter PFWD and MWD (mean, 74 and 265 m) at baseline, as compared with conservatively treated patients (mean, 151 and 472 m, respectively). A logistic regression model indicated that MWD, but not PFWD, remained as an independent predictor of invasive treatment ($P<.001$). Therefore, we used MWD as an index of treadmill walking distance in further analyses. None of the cardiovascular risk factors predicted invasive treatment.

Age-related differences in invasive treatment

To examine whether the predictive value of ABPI/MWD regarding invasive treatment were age dependent, the interaction terms ABPI \times Age and MWD \times Age were analyzed. Both the interaction ABPI \times Age ($P<.0001$) and MWD \times Age ($P<.0001$) were significant. Given these age-dependent effects of PAD severity as a predictor of invasive

treatment, subsequent analyses were performed in two age groups of younger and older patients. Of the 203 patients, 99 (49%) were younger than 65 years (*younger group*), whereas 104 (51%) were 65 years or older (*older group*). Younger patients tended to be more often invasively treated as compared to older patients; i.e., rate of invasive treatment was 55% vs. 42%, respectively ($P=.062$). In younger patients, modes of invasive treatment were PTA ($n=33$), bypass surgery ($n=8$), desobstruction ($n=3$), or combinations of interventions ($n=8$). Invasively treated older patients received PTA ($n=25$), bypass surgery ($n=2$), desobstruction ($n=2$), endarterectomy ($n=3$), or combinations of interventions ($n=9$).

Social support and invasive treatment

Seventy-eight percent of the younger patients had a partner vs. 54% of the older patients. In both age groups, having a partner was not associated with invasive treatment. In younger patients, a high level of social support and limited MWD independently predicted invasive treatment (Table 2). Because in the younger patient group only one person had a positive renal status, this comorbidity factor was excluded from the analysis. In older patients, invasive treatment was determined by poor ABPI (Table 2).

Table 2
Independent predictors of invasive treatment for PAD in younger vs. older patients using multivariate logistic regression analysis

Independent predictors of invasive treatment	OR	95% CI	P
<i>Younger patients</i>			
Age ^a	0.92	0.81–1.03	.152
Sex	0.61	0.17–2.20	.447
Ankle–brachial pressure index	0.83	0.17–4.14	.818
Maximum treadmill-walking distance	15.16	1.53–150.06	.020
Diabetes mellitus	1.89	0.34–10.55	.467
Tobacco use	2.10	0.66–6.65	.207
Hypertension	0.86	0.22–3.35	.833
Hyperlipidemia	0.92	0.29–2.93	.893
Cardiac status	1.87	0.44–7.92	.395
Carotid status	2.80	0.42–18.68	.289
Pulmonary status	2.20	0.09–51.71	.626
High levels of social support	5.44	1.64–18.02	.006
<i>Older patients</i>			
Age ^a	1.01	0.89–1.09	.991
Sex	0.98	0.35–2.92	.758
Ankle–brachial pressure index	4.15	1.34–12.89	.014
Maximum treadmill-walking distance	2.35	0.76–7.27	.139
Diabetes mellitus	0.74	0.19–2.90	.663
Tobacco use	1.11	0.40–3.11	.844
Hypertension	0.38	0.13–1.13	.082
Hyperlipidemia	0.93	0.28–3.04	.898
Cardiac status	0.45	0.13–1.59	.215
Carotid status	1.71	0.21–13.80	.613
Renal status	5.54	0.69–44.66	.108
Pulmonary status	0.36	0.07–1.96	.238
High levels of social support	1.59	0.50–5.07	.429

^a Age was entered as a continuous variable.

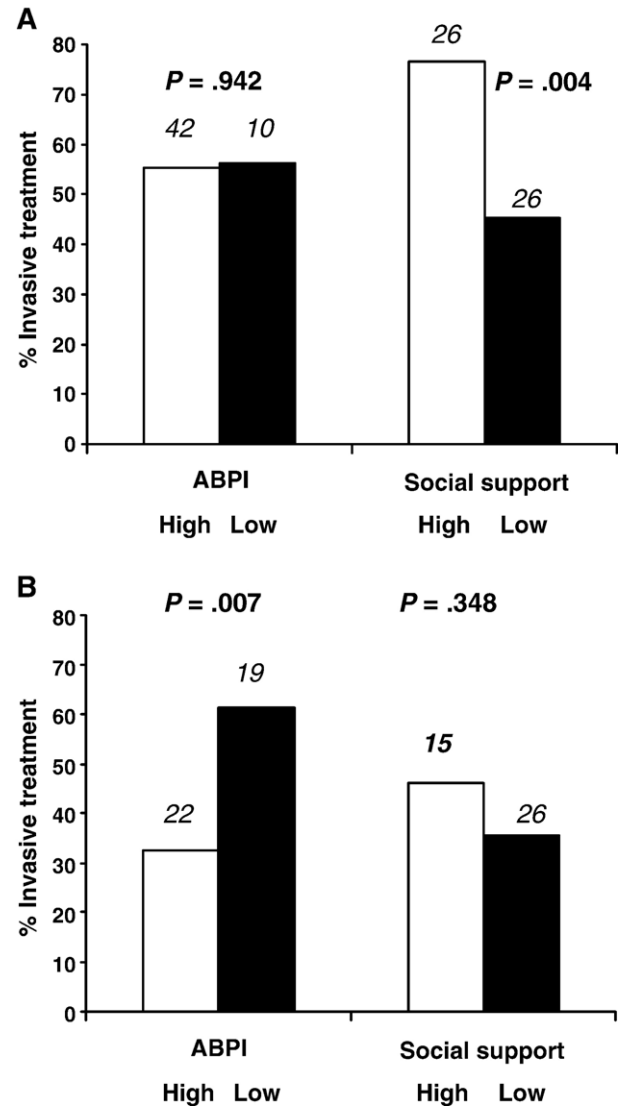


Fig. 1. Invasive treatment in younger patients (A) vs. older patients (B) as a function of ABPI and social support at baseline. Number of patients are presented on top of each bar.

Subsequent analyses focused on the influence of the three subscales of social support: support from family, friends, and significant others. In the younger patients, support from family independently predicted invasive treatment of PAD during follow-up (OR, 3.55; 95%CI, 1.05–12.02; $P=.042$), after controlling for disease severity and risk factors. In older patients, none of the social support subscales were related to invasive treatment.

Next, the percentage of patients with invasive treatment was examined for younger and older patients separately as a function of social support and ABPI (Fig. 1). Almost 80% of younger PAD patients with high levels of social support were treated invasively for their atherosclerotic condition vs. only 45% of the younger patients with relatively poor social support ($P=.004$). Furthermore, while more than 60% of the older patients with low ABPI were treated invasively, only 32% of these patients received in-

vasive treatment when their ABPI was relatively moderate or high ($P=.007$).

Discussion

The findings of the present study highlight the relative effect of PAD severity and social support as determinants of invasive treatment in younger and older PAD patients, in the year following diagnosis. These findings indicate that high levels of social support and limited MWD are the main predictors of invasive treatment in younger patients. Hence, younger patients with adequate levels of social support may feel encouraged to seek more appropriate treatment for their symptoms.

Despite its deleterious effects, PAD remains a relatively underdiagnosed and untreated disease [6]. Previously it has been shown that PAD may cause significant impairments in a patient's lifestyle or occupation for which invasive treatment may be considered [29]. Especially in younger patients with demanding lifestyles, invasive treatment is warranted [10]. This indicates that the clinical decision to consider a patient for invasive treatment depends on more than disease status. Therefore, examining patient-based characteristics that are associated with invasive treatment has become increasingly important.

The present study indicates the importance of perceived social support in PAD. The mechanisms of socially mediated behaviour change have been described in social cognitive theory, e.g., verbal persuasion and vicarious learning [30]. To promote health behaviour and prevent disease progression, the influence of patient's social networks should be taken into account [30]. Social support makes it easier and more practical for patients to engage in healthy behaviour [18] and may influence disease progression by moderating a patient's behaviour [16]. In addition, it may facilitate the process of receiving medical care and diminish stressful factors [16–18]. Patients with high levels of social support may feel encouraged to seek more rigorous treatment for their symptoms. Although social support was not associated with invasive treatment in older patients, it has been shown that help from a social support network with practical tasks may facilitate recovery after hospitalization [31]. It is important to note that in the present study, having a partner was not related to invasive treatment for PAD. Although subscale analyses in the younger patient group indicated that support from family was independently associated with invasive treatment, this effect may have occurred due to chance because we did not correct for multiple comparisons. It is primarily the combination of support from friends, family, and significant others that predicts invasive treatment for PAD.

In older patients, poor ABPI was associated with more invasive treatment. This evidence suggests that both disease severity and patient-based characteristics are taken into account by the vascular surgeon in the decision to

consider a patient for invasive treatment. As has been suggested previously, treatment should be individualized based on the degree of lifestyle limitations that are encountered by a patient [32]. Younger patients often have a more demanding lifestyle than do elderly patients. In combination with the possible risk of invasive treatment, rigorous treatment may be more suitable for younger patients [10]. The results from the present study support this notion. Findings from our previous research in another sample of PAD patients showed that impaired health status independently predicted invasive treatment in these patients [28]. This also indicates the importance of accounting for patient-based psychological factors in treatment of PAD.

With regard to disease severity, we found that limited MWD was a strong predictor of invasive treatment for PAD, both in the total study population and in the group of patients younger than 65 years. Moreover, low ABPI was an important predictor of invasive treatment in the elderly patients. These findings are in line with previous studies [7]. It has also been shown in other studies that low ABPI was associated with cardiovascular mortality and morbidity in PAD patients [33,34]. A longer follow-up period is needed to obtain more information on morbidity and mortality in the present study. Furthermore, our study did not include asymptomatic PAD patients or patients with chronic critical limb ischemia. This could make generalization of the results to other forms of PAD difficult. Patients with PAD may be asymptomatic and have latent disease [35]. These patients are often unaware of their disease status and do not seek treatment for their condition. Patients with chronic critical limb ischemia, a severe form of PAD, are often elderly and frail, and their long-term survival is worse than that of patients with intermittent claudication [36].

Overall, the findings from the present study provide evidence for the predictive value of perceived social support, in addition to traditional clinical indicators, with regard to invasive treatment of intermittent claudication in younger patients. These results have implications for further clinical research and practice. In order to provide optimal treatment, some patients may need more intensive follow-up or additional care. Results from the present research suggest that additional care in these high-risk PAD patients may be aimed at modifying psychological factors such as social support. Findings from the Enhancing Recovery in Coronary Heart Disease (ENRICHD) trial, in which cardiac patients with low perceived social support received cognitive behaviour therapy, indicated that social isolation had improved after treatment [37]. Although the relative improvement was less than expected, these findings are important since they indicate the possibility to change perceived social support levels in high-risk patients. Future studies should therefore examine possible behavioural pathways, such as seeking treatment, through which social support may influence adverse clinical outcomes.

In conclusion, younger PAD patients with inadequate social support may fail to seek appropriate treatment, indicating the need to consider psychological factors in optimizing treatment of atherosclerotic vascular disease in this high-risk group. Furthermore, social support may influence the process of modifying atherosclerotic risk factors, which is also an important aspect of treatment of intermittent claudication [32]. In case of socially isolated patients who may fail to seek appropriate treatment for their condition, additional (practical) support is needed to improve behaviour modification and treatment adherence, or to arrange practical support during a patient's recovery from invasive treatment. Social support is an important aspect that should be assessed in PAD patients, especially in the relatively younger patients with an atherosclerotic condition.

References

- [1] Murabito JM, Evans JC, Nieto K, Larson MG, Levy D, Wilson PW. Prevalence and clinical correlates of peripheral arterial disease in the Framingham Offspring Study. *Am Heart J* 2002;143:961–5.
- [2] Selvin E, Erlinger TP. Prevalence of and risk factors for peripheral arterial disease in the United States: results from the National Health and Nutrition Examination Survey, 1999–2000. *Circulation* 2004;110:738–43.
- [3] McPhail IR, Spittell PC, Weston SA, Bailey KR. Intermittent claudication: an objective office-based assessment. *J Am Coll Cardiol* 2001;37:1381–5.
- [4] Stewart KJ, Hiatt WR, Regensteiner JG, Hirsch AT. Exercise training for claudication. *N Engl J Med* 2002;347:1941–51.
- [5] Breek JC, Hamming JF, De Vries J, Aquarius AE, Berge Henegouwen DP. Quality of life in patients with intermittent claudication using the World Health Organisation (WHO) questionnaire. *Eur J Vasc Endovasc Surg* 2001;21:118–22.
- [6] Belch JJ, Topol EJ, Agnelli G, Bertrand M, Califf RM, Clement DL, et al. Critical issues in peripheral arterial disease detection and management: a call to action. *Arch Intern Med* 2003;163:884–92.
- [7] Dormandy JA, Rutherford RB. Management of peripheral arterial disease (PAD) TASC Working Group TransAtlantic Inter-Society Consensus (TASC). *J Vasc Surg* 2000;31:S1–S296.
- [8] Breek JC, De Vries J, Van Heck GL, van Berge Henegouwen DP, Hamming JF. Assessment of disease impact in patients with intermittent claudication: discrepancy between health status and quality of life. *J Vasc Surg* 2005;41:443–50.
- [9] Ouriel K. Peripheral arterial disease. *Lancet* 2001;358:1257–64.
- [10] Feinglass J, Mc Carthy WJ, Slavensky R, Manheim LM, Martin GJ. Effect of lower extremity blood pressure on physical functioning in patients who have intermittent claudication. The Chicago Claudication Outcomes Research Group. *J Vasc Surg* 1996;24:503–11 [discussion 511–2].
- [11] Chee JH, Filion KB, Haider S, Pilote L, Eisenberg MJ. Impact of age on hospital course and cost of coronary artery bypass grafting. *Am J Cardiol* 2004;93:768–71.
- [12] Goldberg RJ, McCormick D, Gurwitz JH, Yarzebski J, Lessard D, Gore JM. Age-related trends in short- and long-term survival after acute myocardial infarction: a 20-year population-based perspective (1975–1995). *Am J Cardiol* 1998;82:1311–7.
- [13] Reeve GM, Maslach C. Use of social support: gender and personality differences. *Sex Roles* 2001;44:437–59.
- [14] Rozanski A, Blumenthal JA, Davidson KW, Saab PG, Kubzansky L. The epidemiology, pathophysiology, and management of psychosocial risk factors in cardiac practice: the emerging field of behavioral cardiology. *J Am Coll Cardiol* 2005;45:637–51.
- [15] Di Matteo MR. Social support and patient adherence to medical treatment: a meta-analysis. *Health Psychol* 2004;23:207–18.
- [16] Bosworth HB, Stechuchak KM, Grambow SC, Oddone EZ. Patient risk perceptions for carotid endarterectomy: which patients are strongly averse to surgery? *J Vasc Surg* 2004;40:86–91.
- [17] Mookadam F, Arthur HM. Social support and its relationship to morbidity and mortality after acute myocardial infarction: systematic overview. *Arch Intern Med* 2004;164:1514–8.
- [18] Boutin-Foster C. Getting to the heart of social support: a qualitative analysis of the types of instrumental support that are most helpful in motivating cardiac risk factor modification. *Heart Lung* 2005;34:22–9.
- [19] Frasure-Smith N, Lesperance F, Gravel G, Masson A, Juneau M, Talajic M, et al. Social support, depression, and mortality during the first year after myocardial infarction. *Circulation* 2000;101:1919–24.
- [20] Krumholz HM, Butler J, Miller J, Vaccarino V, Williams CS, Mendes de Leon CF, et al. Prognostic importance of emotional support for elderly patients hospitalized with heart failure. *Circulation* 1998;97:958–64.
- [21] Brummett BH, Barefoot JC, Siegler IC, Clapp-Channing NE, Lytle BL, Bosworth HB, et al. Characteristics of socially isolated patients with coronary artery disease who are at elevated risk for mortality. *Psychosom Med* 2001;63:267–72.
- [22] Whiteman MC, Deary IJ, Fowkes FG. Personality and social predictors of atherosclerotic progression: edinburgh artery study. *Psychosom Med* 2000;62:703–14.
- [23] Newman AB, Shemanski L, Manolio TA, Cushman M, Mittelmark M, Polak JF, et al. Ankle–arm index as a predictor of cardiovascular disease and mortality in the Cardiovascular Health Study. The Cardiovascular Health Study Group. *Arterioscler Thromb Vasc Biol* 1999;19:538–45.
- [24] Hiatt WR, Hirsch AT, Regensteiner JG, Brass EP. Clinical trials for claudication. Assessment of exercise performance, functional status, and clinical end points. *Vascular Clinical Trialists. Circulation* 1995;92:614–21.
- [25] Breek JC, Hamming JF, De Vries J, van Berge Henegouwen DP, van Heck GL. The impact of walking impairment, cardiovascular risk factors, and comorbidity on quality of life in patients with intermittent claudication. *J Vasc Surg* 2002;36:94–9.
- [26] Rutherford RB, Baker JD, Ernst C, Johnston KW, Porter JM, Ahn S, et al. Recommended standards for reports dealing with lower extremity ischemia: revised version. *J Vasc Surg* 1997;26:517–38.
- [27] Blumenthal JA, Burg MM, Barefoot J, Williams RB, Haney T, Zimet G. Social support, type A behavior, and coronary artery disease. *Psychosom Med* 1987;49:331–40.
- [28] Aquarius AE, Denollet J, Hamming JF, Breek JC, De Vries J. Impaired health status and invasive treatment in peripheral arterial disease: a prospective one-year follow-up study. *J Vasc Surg* 2005;41:436–42.
- [29] Beard JD. ABC of arterial and venous disease: chronic lower limb ischaemia. *BMJ* 2000;320:854–7.
- [30] Bandura A. Health promotion by social cognitive means. *Health Educ Behav* 2004;31:143–64.
- [31] Wilcox VL, Kasl SV, Berkman LF. Social support and physical disability in older people after hospitalization: a prospective study. *Health Psychol* 1994;13:170–9.
- [32] Beebe HG. Intermittent claudication: effective medical management of a common circulatory problem. *Am J Cardiol* 2001;87:14D–8D.
- [33] Hooi JD, Stoffers HE, Kester AD, van RJ, Knottnerus JA. Peripheral arterial occlusive disease: prognostic value of signs, symptoms, and the ankle–brachial pressure index. *Med Decis Making* 2002;22:99–107.
- [34] McDermott MM, Feinglass J, Slavensky R, Pearce WH. The ankle–brachial index as a predictor of survival in patients with peripheral vascular disease. *J Gen Intern Med* 1994;9:445–9.

- [35] McDermott MM, Greenland P, Liu K, Guralnik JM, Criqui MH, Dolan NC, et al. Leg symptoms in peripheral arterial disease: associated clinical characteristics and functional impairment. *JAMA* 2001;286:1599–606.
- [36] Walker SR, Yusuf SW, Hopkinson BR. A 10-year follow-up of patients presenting with ischaemic rest pain of the lower limbs. *Eur J Vasc Endovasc Surg* 1998;15:478–82.
- [37] Berkman LF, Blumenthal J, Burg M, Carney RM, Catellier D, Cowan MJ, et al. Effects of treating depression and low perceived social support on clinical events after myocardial infarction: the Enhancing Recovery in Coronary Heart Disease Patients (ENRICH) Randomized Trial. *JAMA* 2003;289:3106–16.

Appendix A. Grading system for cardiovascular risk factors according to the Society for Vascular Surgery/ North American Chapter of the International Society for Cardiovascular Surgery [26]

Diabetes:

- 0 = none
 1 = adult onset; controlled by diet or oral agents
 2 = adult onset, insulin controlled
 3 = juvenile onset

Smoking:

- 0 = none or none for last 10 years
 1 = none current, but smoked in last 10 years
 2 = current (includes abstinence less than 1 year), less than 1 pack/day
 3 = current, greater than 1 pack/day

Hypertension:

- 0 = none, diastolic pressure usually lower than 90 mmHg
 1 = controlled with single drug
 2 = controlled with two drugs
 3 = requires more than two drugs or uncontrolled

Hyperlipidemia:

- 0 = cholesterol (low-density lipoprotein and total) and triglyceride levels within normal limits for age
 1 = mild elevation, controllable by diet
 2 = requiring strict dietary control
 3 = requiring dietary and drug control

Cardiac status:

- 0 = asymptomatic, normal ECG

- 1 = asymptomatic, remote myocardial infarction (MI) by history (>6 months), occult MI by ECG, or fixed defect on dipyridamole thallium or similar scan
 2 = any one of stable angina, no angina but significant reversible perfusion defect on dipyridamole thallium scan, significant silent ischemia (=1% of time) on Holter monitoring, ejection fraction 25% to 45%, controlled ectopy or asymptomatic arrhythmia, history of congestive heart failure (CHF) that is now well compensated for
 3 = any one of unstable angina, symptomatic or poorly controlled ectopy or arrhythmia, poorly compensated or recurrent CHF, ejection fraction less than 25%, MI within 6 months

Carotid disease:

- 0 = no symptoms, no evidence of disease
 1 = asymptomatic but with evidence of disease determined by duplex scan or other accepted noninvasive test or arteriogram
 2 = transient or temporary stroke
 3 = completed stroke with permanent neurologic deficit or acute stroke

Renal status (refers to stable levels, not transient drops or elevations in response to intravenous medication, hydration, or contrast media):

- 0 = no known renal disease, normal serum creatinine level
 1 = moderately elevated creatinine level, as high as 2.4 mg/dl
 2 = creatinine level, 2.5 to 5.9 mg/dl
 3 = creatinine level >6.0 mg/dl, or on dialysis or with kidney transplant

Pulmonary status:

- 0 = asymptomatic, normal chest X-ray film, pulmonary function test (PFT) within 20% of predicted
 1 = asymptomatic or mild dyspnea on exertion, mild chronic parenchymal X-ray changes, PFT 65% to 80% of predicted
 2 = between 1 and 3
 3 = vital capacity less than 1.85 l, FEV1 less than 1.2 l or less than 35% of predicted, maximal voluntary ventilation less than 50% of predicted, PCO₂ greater than 45 mmHg, supplemental oxygen use medically necessary, or pulmonary hypertension.