Objective: To assess levels of physical activity, particularly walking and leg exercises, among patients with venous leg ulcers and the extent to which patients adhere to compression therapy.

Design: Descriptive cross-sectional study.

Setting: Patients from 12 outpatient dermatology clinics were invited to participate in this study. When they agreed, they were asked to wear an accelerometer for a week and were then interviewed at the outpatient clinic.

Patients: A total of 150 patients with leg ulcers caused mainly by venous insufficiency.

Main Outcome Measures: The amount of moderately strenuous physical activity, the amount of walking, and adherence to compression therapy.

Results: In this study, 39% of the patients interviewed displayed adherence to compression therapy. Self-reported data validated by the use of an accelerometer indicated that the amount of moderately strenuous activity in the study group was low compared with that of the general Dutch population; 35% of the patients did not have a 10-minute walk even once a week.

Conclusions: Low levels of physical activity were established in a group of 150 patients with venous leg ulcers. Full adherence to compression therapy was reported in about 40% of the patients. Patients should be educated and encouraged to (1) enhance physical activity through walking and leg exercises and (2) increase adherence to compression therapy.
To what extent do patients adhere to compression therapy by means of therapeutic elastic stockings or bandages?

**METHODS**

**PATIENTS AND PROCEDURE**

Interviews of 150 patients were conducted by a team of 3 trained interviewers (1 of whom was M.M.H.). Patients from 12 hospital-based outpatient dermatology clinics in the Netherlands were included. The study was approved by the medical ethics committees of all participating hospitals.

Patients with leg ulcers who had received treatment at outpatient dermatology clinics during the 9-month inclusion period of the study were asked to participate (at the start of the study, patients who had been treated within the preceding month were also invited to participate). Only patients with leg ulceration based on venous etiology or a mixed etiology of venous and arterial or venous and arteriolar insufficiency were invited to participate. To be included in the study, patients had to be able to speak and understand the Dutch language. In addition, participants were required to provide written informed consent after they received written and oral information about the study. Exclusion criteria included arterial insufficiency with an ankle-brachial pressure index of less than 0.8 or full immobility.

Patients were interviewed at the outpatient dermatology clinic where they were being treated. All participants were initially approached by dermatology nurses and/or dermatologists and asked if they would be willing to participate in this study. Patients were asked to wear an accelerometer (hereinafter, PAM [physical activity monitor]) during the week prior to interview and were given instructions for its use.

**ASSESSMENTS AND OBSERVATIONS**

Data on wound characteristics and etiology and comorbidity were provided by the dermatologist or dermatology nurse. Patients were also asked to report comorbidity, the duration of the current wound, and the date of the first wound.

In addition, patients were asked to report whether they conducted leg exercises, the type of exercises, and how often they conducted these exercises. Six questions on adherence to compression therapy were presented to determine actual treatment adherence behavior. Answers were registered in prestructured categories. The questions and categories are displayed in the **Figure**. Additional remarks from the patients concerning their experiences with compression therapy were reported at the end of the interviews.

Footwear was observed by the interviewer, and patients were questioned at whether their footwear on that day was the footwear they usually wore. The interviewer judged the quality of the footwear and paid special attention to the height of the heels (whether height was <4 cm) and the supportive capacity of the shoe. Dermatology nurses were asked to report if they had an indication for nonadherence to treatment regimen through observation of the compression bandages or therapeutic elastic stockings or the amount of edema in the lower legs.

**QUESTIONNAIRES AND PAM**

All patients completed the 7-day Physical Activity Recall questionnaire (PAR), which asks respondents to recall and report all physical activity in which they had engaged during the previous 7 days. A distinction was made between weekdays and weekends. The PAR requires respondents to report any moderately strenuous activities in the past week and the amount of time spent on these activities. To increase understanding of what

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**Figure**. Questions and scoring list to determine adherence with compression therapy.
kinds of activities are considered moderately strenuous, examples were provided on the back of the questionnaire. Furthermore, the amount of walking the patient had done in the week prior to the interview was investigated using a question derived from the International Physical Activity Questionnaire.6 This question asked patients how often in the previous week they had walked for a minimum of 10 minutes.

To measure actual physical activity, a PAM was used.18-21 The PAM is a small device that can be attached to the waistband of trousers or a skirt and contains a display that shows different scores of physical activity, namely, a daily score and a mean weekly score. The PAM was used as a control device for overreporting of physical activity.

We used descriptive analysis to analyze the data in this study. Scores for self-reported physical activity were combined with PAM scores to validate self-reported activity. Self-reported adherence to compression was combined with dermatology nurses’ observations.

RESULTS

In total, 227 patients were invited to participate in our study. Of these, 77 (34%) chose not to participate for the following reasons: (1) 29 patients considered participating in this study to be too much trouble (many of these patients were dependent on others for transportation to the hospital), (2) 16 patients were unable to participate because they or their partners were unwell, and (3) 11 did not have time to participate because of work commitments or other activities. (Twenty-one patients did not provide a specific reason for not participating.)

PATIENT CHARACTERISTICS

Table 1 presents patient characteristics, wound characteristics, and comorbidity. In 60% of the patients, the leg ulcer was the result of a mixed etiology of venous and arterial or arteriolar insufficiency. All patients with diabetes mellitus, heart failure, hypertension, or intermittent claudication were also classified as patients with a mixed etiology. Patients who had a leg ulcer based on a pure venous etiology comprised 40% of the sample. Almost three-quarters of the patients had varicose veins (71%), and more than one-third had a history of deep venous thrombosis (35%). At the time of the interviews, 103 patients had a wound (69%). Forty-seven patients had had a wound in the month prior to the interview (31%). Almost one-fifth of the patients had had wounds on more than 10 occasions (19%). The median duration of the wound was 4 months (range, 2 weeks to 5 years). Compression therapy was applied by short or long stretch bandages or therapeutic elastic stockings. Some patients had both because they had different types of compression on each leg.

PHYSICAL ACTIVITY

In Table 2, the data for physical activity, walking, and leg exercises are displayed. The results of the PAR, corrected for overreporting, showed that 56% of the patients had less than 2.5 hours of physical activity a week and about half of these patients (26%) did not have any moderately strenuous physical activity in the week prior to the interview. The PAM scores of 17 patients (11%) were corrected for the amount of physical activity per week, and 12 (8%) were corrected for the amount of walking in the week previous to the interview. Patients who reported more than 2.5 hours on the PAR and had a score higher than 9 on the PAM were classified as the moderately strenuous activity group.

Only 13% of the patients had walked for 30 minutes on at least 5 days of the week. The percentage of patients who did not walk for 10 minutes at least once in
had experience with therapeutic elastic stockings, 33% as well as compression bandages. Of the 119 patients who fully adhered to the use of therapeutic elastic stockings, 33% reported being completely adherent to therapy.

Activation of the calf muscle pump function combined with compression therapy is the most effective noninvasive component of venous leg ulceration treatment. This study provides insight into levels of physical activity among patients with venous leg ulcers, particularly walking and leg exercises, and patient adherence to compression therapy. The results of this study show that moderately strenuous activity levels in patients with venous leg ulcer are low. A substantial number of patients do not engage in even 10 minutes of walking per week. In addition, this study shows that only one-third of the patients conducted leg exercises. The rate of adherence to compression therapy was also low, with less than half of the patients reporting full adherence to therapy.

To our knowledge, there are no studies in the international literature that report on the physical activity and walking behavior of patients with venous leg ulcers. There was, however, a study in the Netherlands (where our patient sample was obtained) in which 8000 members of the general population were questioned about their physical activity. The patients in our sample showed lower physical activity levels compared with the sample surveyed among the general Dutch population, thereby indicating that our sample was comparatively more inactive. In the Dutch adult population, more than 50% were sufficiently physically active compared with 44% of the patients in our sample. Furthermore, in the Dutch study, only 8% of the sample were completely inactive compared with 26% of the patients in our sample.

Clearly, patients with venous leg ulcers have low levels of physical activity and spend little time walking even though walking activates the calf muscle pump and reduces venous hypertension when combined with compression therapy. There are, however, no guidelines that indicate the amount of walking necessary to improve venous insufficiency. In the study reported herein, the actual amount of walking was assessed using reports of 10-minute walking periods, because 10-minute walking periods ensure that the calf muscle is sufficiently activated. A study by Uden et al established that walking faster is more effective in promoting venous circulation of the lower legs. The amount of walking to achieve beneficial effects with respect to decreasing venous leg ulceration needs to be further established by future research.

Most patients in our study were classified as moderately adherent to compression therapy. A smaller group was categorized as nonadherent. In a study by Mayberry et al, nonadherence was established for only 9.7% of the patients. However, at follow-up, this number increased to 20.5%. Erickson et al showed that strict adherence was established in 32% of the cases in their study, which is more on par with the results of our study. Ob-

### Table 2. Amount of Moderately Strenuous Activity, Walking, and Leg Exercises in 150 Patients

<table>
<thead>
<tr>
<th>Physical Activity, PAR</th>
<th>Patients, No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSA, ≥ 2.5 h</td>
<td>66 (44)</td>
</tr>
<tr>
<td>No MSA</td>
<td>39 (26)</td>
</tr>
<tr>
<td>Walking</td>
<td></td>
</tr>
<tr>
<td>≥ 30 min on ≥ 5 d</td>
<td>19 (13)</td>
</tr>
<tr>
<td>&lt; 10 min on ≥ 1 d</td>
<td>52 (35)</td>
</tr>
<tr>
<td>Don’t know</td>
<td>11 (7)</td>
</tr>
<tr>
<td>Leg and foot exercises</td>
<td></td>
</tr>
<tr>
<td>Leg exercises</td>
<td>53 (35)</td>
</tr>
<tr>
<td>Flexing and stretching the feet</td>
<td>30 (20)</td>
</tr>
<tr>
<td>Rotating the feet</td>
<td>35 (23)</td>
</tr>
<tr>
<td>Tip-toe exercise</td>
<td>11 (7)</td>
</tr>
</tbody>
</table>

Abbreviations: MSA, moderately strenuous activity; PAR, Physical Activity Recall Questionnaire.

- a Defined as at least 2.5 hours per week.
- b Self-reported data corrected for physical activity monitor (PAM) scores. The PAM corrections explained that at least 30 minutes of walking on at least 5 days per week, or at least 2.5 h of MSA, are not possible when the mean daily PAM score is 9 or less.
- c A total of 26 patients with self-reported 2.5 hours or more of MSA per week had a mean weekly score on the PAM of less than 10, but 9 patients reported bicycling as MSA, so only 17 patients were corrected for PAM in their physical activity score because PAM scores are known to underestimate activity during bicycling.

### Table 3. Adherence by 150 Patients to Compression Therapy Using Therapeutic Elastic Stockings and/or Bandages

<table>
<thead>
<tr>
<th>Level of Adherence</th>
<th>Type of Therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stockings or Long Stretch Bandages (n = 119)</td>
</tr>
<tr>
<td>Fully adherent (on a daily basis, according to guidelines)</td>
<td>40 (33)</td>
</tr>
<tr>
<td>Moderately adherent (occasionally to regularly; a period &lt; 2 h shorter rather than all day)</td>
<td>46 (38)</td>
</tr>
<tr>
<td>Nonadherent (occasionally, considerably shorter; a period &gt; 2 h shorter rather than all day)</td>
<td>35 (29)</td>
</tr>
</tbody>
</table>

- a Data are given as number (percentage) of patients.
- b Regardless of the kind of compression.
viously, adherence or adherence rates are influenced by the methods used to obtain results. The patients in the studies by Mayberry et al\textsuperscript{12} and Erickson et al\textsuperscript{10} were considered to be adherent to therapy when they did not consistently refuse to use ambulatory elastic compression or when they kept 100\% of their appointments, adhered completely to prescribed compression therapy, and followed all instructions for wound and extremity care. Kjaer et al\textsuperscript{13} stated that the indicator used to determine adherence is susceptible to bias. In our study, adherence was assessed by questioning the patients on their daily habits concerning compression therapy. Patients were invited and encouraged to tell the interviewer about their experiences with their compression bandages and stockings. In many cases, when the interviewer asked patients specifically about their habits concerning compression therapy, many reported a lower adherence level than what they had initially reported. Evidently, by discussing experiences and habits concerning compression in a nonjudgmental way, the provision of socially desirable answers was diminished.

Several studies\textsuperscript{10-13} have concluded that patients who display strict adherence with their treatment regimen show considerably faster healing rates and fewer recurrences compared with patients who are less adherent or nonadherent. A high level of adherence is, according to the World Health Organization review (Sabate\textsuperscript{25}), associated with more severe symptoms or illness, knowledge about and belief in efficacy of treatment, adequate social support, and trust in the physician.\textsuperscript{14} Renzi et al,\textsuperscript{26} in a study of patients being treated for dermatologic concerns, concluded that dissatisfaction with care was associated with poor adherence to treatment. Unfortunately, few studies report on the determinants of nonadherence with compression therapy. A study by Edwards\textsuperscript{27} concluded that many patients do not have a clear understanding of their condition or the treatment regimes prescribed. In addition, Edwards\textsuperscript{27} indicated that concurrent problems associated with compression bandaging (eg, pain, leakage of exudates, and skin irritation) contribute to nonadherence. In a study by Kiev et al,\textsuperscript{28} socioeconomic factors, cosmetic reasons, concerns about discomfort, and difficulty in putting on the stockings were identified as primary reasons for nonadherence.

A limitation of our study is the fact that a relatively large number of patients declined participation. It is possible that this created a selection bias. Another limitation is related to the fact that the sample of patients with venous leg ulcers in our study was obtained from outpatient dermatology clinics. In the Netherlands, most patients with uncomplicated venous leg ulceration are treated by general practitioners and/or nurses from home health care organizations. Patients with poorly healing wounds, recurrent wounds, or wounds related to more complicated etiology are referred to outpatient dermatology clinics. As a result, the generalizability of our findings is probably limited to patients with more severe venous leg ulceration concerns. However, generalizability of our results is likely enlarged because the patients included were recruited from a large number of outpatient dermatology clinics in both academic and general hospitals in the Netherlands.

The validity of this study is strengthened by the use of several methods, such as self-reported data, validated questionnaires, data from the medical files, observational data from dermatology nurses, and interviewers and the use of a PAM. Using a PAM allowed us to objectively measure actual physical activity along with self-reported physical activity. In our study, the PAM was used specifically to control for overreporting of physical activity by the patients rather than to measure the total amount of physical activity.

In conclusion, patients with venous leg ulcers treated with ambulant compression therapy have low levels of physical activity and spend little time walking. Levels of full adherence with compression therapy are low. Physical activity through walking and leg exercise, combined with compression therapy, is the most effective element of conservative leg ulceration treatment. Patients should be encouraged to enhance physical activity that aims to activate the calf muscle pump. Patients should be stimulated to increase adherence to treatment with compression bandages or stockings. Determinants for enhancing adherence and physical activity levels need to be further explored and anticipated at as a part of professional care.

Accepted for Publication: May 29, 2007.
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Financial Disclosure: None reported.

Funding/Support: This study was funded by a grant from ZonMw, the Netherlands’ organization for Health Research and Development.

Role of the Sponsor: The funding organization did not have a role in the design and conduct of the study or in the approval of this manuscript.

REFERENCES


