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## Availability of Supervised Exercise Programs and the Role of Structured Home-based Exercise in Peripheral Arterial Disease

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### WHAT THIS PAPER ADDS?

- This international survey found that supervised exercise programs appear to remain underutilized in Europe, despite the current guidelines. Structured, home-based exercise with the use of exercise logbooks, pedometers and specific walking advice may provide an effective alternative, especially when the facilities or funding for supervised exercise programmes are not available. A systematic review of the evidence is presented, which identified studies supporting the above statement; however, more randomized trials are warranted before final conclusions can be reached.

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### ABSTRACT

**Objectives:** The effectiveness of supervised exercise programs (SEPs) for the management of peripheral arterial disease (PAD) can be hampered by low accessibility and poor compliance. The current international availability and use of SEPs was evaluated and the evidence on alternative approaches such as structured, home-based exercise programs (HEPs) was reviewed.

**Methods-materials:** International survey on SEP availability among vascular surgeons using an online questionnaire. A systematic review on structured-HEPs effectiveness was also performed.

**Results:** A total of 378 responses were collected from 43 countries, with the majority (95%) from Europe. Only 30.4% of the participants had access to SEPs and within this group there was significant heterogeneity on the way SEPs were implemented. This systematic review identified 12 studies on the effectiveness of HEPs. In 3 studies SEPs were superior to HEPs in improving functional capacity or equivalent in improving quality of life (QoL). HEPs significantly improved most of the functional capacity and QoL markers when compared to the “go home and walk” advice and baseline measurements.

**Conclusions:** SEPs remain an underutilized tool despite recommendations. Structured HEPs may be effective and can be useful alternatives when SEPs are not available. Further research is warranted to establish cost-effectiveness.

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### Introduction

Supervised exercise programs (SEPs) have been recognised as an effective treatment modality in patients with stable, peripheral arterial disease (PAD).<sup>1</sup> They are well supported by level I evidence,

which is based on the TASC II Inter-Society Consensus for the management of PAD and the Scottish Intercollegiate Guidelines Network (SIGN).<sup>2</sup>

The SEPs have been shown to increase pain-free walking time and maximal walking time by more than 100% in patients with claudication<sup>1</sup> and they are considered a superior<sup>3</sup> and cost-effective alternative<sup>4</sup> to the plain “go home and walk” advice (GHWA) usually given to patients. In addition they have been shown to improve the functional capacity and the ankle-brachial pressure index (ABPI) when used in conjunction with endovascular treatment and best

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medical management.<sup>5</sup> Higher levels of physical activity, such as those achieved by supervised exercise, have also been associated with less functional decline among patients with PAD<sup>6–8</sup> which is another serious implication of the disease.

Despite the above evidence and the current recommendations it has been shown that SEPs remain an underutilised tool. Davies et al, showed that only 24% of British surgeons had access to SEPs<sup>9</sup> and only a minority were using them according to the proposed guidelines. Three years later this international survey was performed to assess the current status on the availability and use of SEPs.

In addition, the evidence on other novel approaches designed to increase physical activity in patients with PAD was evaluated. These included structured, home-based or community exercise programs (HEPs). The HEPs could be a solution that combines the structured approach to exercise and the monitored environment seen in SEPs with the convenience and lower cost of a home-based approach. A systematic review was performed regarding the effectiveness of HEPs in improving functional capacity and quality of life in comparison to other established management practices such as the SEPs and the plain GHWA.

## Methods

### Survey design

An online, international survey was performed using the web-based survey platform called [www.surveymonkey.com](http://www.surveymonkey.com). The questionnaire was designed by GC Makris and G Geroulakos in order to provide data on the use and availability of SEPs. The questionnaires consisted of 9 multiple-choice questions and open text space when clarifications were necessary (Table 1). The following link was created for the online version of the questionnaire: [www.surveymonkey.com/s/DSKPQM6](http://www.surveymonkey.com/s/DSKPQM6) and sent electronically to all the participants. Each participant could respond only once. Frequent reminders were sent to those that did not answer during a 3-month period.

### Survey participants

The online questionnaire was sent to the email addresses of vascular surgeons worldwide. The link was forwarded with the kind help of the European Society of Vascular surgery and the International Society of Vascular Surgery. It was also sent by the authors using the email accounts available through the member lists found at the online websites and yearbooks of other vascular societies such as the Royal Society of Medicine, the vascular society of Great Britain and Ireland and the Hellenic vascular society. The specialists were contacted directly and not via their institutions and thus their answers represent their personal experience. The selection process was solely dependent on the availability of a relevant database for each country as well as from the collaboration of the local vascular society. The location of their practice was requested from the participants but additional information about the hospital setting or the number of patients seen was not required in order to keep the questionnaire as brief as possible.

### Data collection and analysis

The responses to the online questionnaire were automatically collected by the online survey platform and the data was extracted by the authors. The PASW statistical package (version 18, SPSS inc, Chicago, Ill, USA) was used for statistical analysis. The open text responses were collected separately and analysed manually.

**Table 1**

The questionnaire used for the purposes of the international survey on the availability of supervised exercise programs.

- 
1. Please state the country of your practice:
    - Drop menu
  2. Do you have access to supervised exercise programme (SEP) for claudicants?
    - Yes
    - No
    - I don't know
  3. How many of your patients with Fontain II claudication are being referred to SEP?
    - All of them
    - More than 50%
    - Less than 50%
    - None
    - Don't have access
  4. What is the duration of every SEP session?
    - Less than 1 h
    - 1–2 h
    - More than 2 h
    - Don't have access
  5. Who leads the SEP? (Please indicate all that apply)
    - Doctor
    - Nurse
    - Physiotherapist
    - Other healthcare professional
    - Non-healthcare professional
    - Don't have access
  6. What is the total duration of the SEP?
    - Less than 3 months
    - More than 3 months and less than 6 months
    - More than 6 months
    - Don't have access
  7. After the end of the SEP how do you monitor the physical activity of your patients?
    - I bring them back to clinic every 6 months
    - I give the specific instructions about how much they should walk every day and at what speed and intensity
    - I give them specific instructions and I ask them to keep an exercise diary
    - Other (free text available)
  8. If no SEP is available or wanted, what kind of walking advice do you provide to your claudication patients?
    - I tell them to go home and walk as much as possible
    - I give the specific instructions about how much they should walk every day and at what speed and intensity
    - I give them specific instructions and I ask them to keep an exercise diary
    - Other (free text available)
  9. Would you be interested in using an online coaching platform for home-based exercise for your patients?
    - Yes, if there is evidence
    - Maybe
    - No
- 

### Review criteria

The PubMed, Scopus and Cochrane databases were searched systematically by two independent reviewers (GCM, A Lavidas) for clinical studies evaluating the effectiveness of structured, home-based exercise programs. In case of a disagreement regarding the inclusion or exclusion of a study, a third more senior investigator (C Lattimer) was consulted. The search terms used were: “home-based exercise”, “community based exercise”, “peripheral arterial disease”, and “claudication” in various combinations. The selected studies were searched manually for relevant publications (published between 1990 and 2012) from their reference list. All clinical studies, which reported results on the effect of specific, structured,

home-based or community based exercise modalities on walking performance in PAD patients with or without comparisons with established modalities (SEPs, GHWA) were retrieved and analysed. Information about the study design, patients' characteristics, outcome measures and final conclusions of the study were sought and extracted. Studies reporting only the effect of the GHWA were not considered as structured, home-based exercise programs and were not included in the analysis. The end of search was June 2012.

## Results

### International survey

#### Survey characteristics and participants

The online survey was open from November 2011 until the end of January 2012. From a total of 1673 online questionnaires which were sent to vascular surgeons internationally, 36 bounced back as undelivered and 21 opted out of the survey. Finally, 378 responses were collected from 43 countries with 360 responses (95%) from Europe, 34% from England and 10.5% from Greece.

#### Availability and use of SEPs

From the total 378 participants only 30.4% (115) had access to SEPs while 2.1% had no information on the existence of such programs in their hospital. However, even within the group of those who had access to SEPs, only 18.4% (21/115) would refer all their patients to a SEP, while 43.4% (50/115) of them would refer less than 50% of their patients.

Regarding the implementation of SEPs, 36.5% (42/115) would specify a duration of less than an hour, 53.1% (61/115) would last between 1 and 2 h and 10.4% (12/115) would last more than 2 h. The total duration of SEPs would be less than 3 months in 22.6% (26/115), between 3 and 6 months for 56.5% (65/115) and more than 6 months for 20.8% (24/115). The majority of these SEPs (48.1%) were run by physiotherapists and 36.5% by doctors. After the completion of SEPs 70.4% of the specialists would bring their patients back for a follow-up appointment.

If SEPs were not available or needed, 30.2% (114/378) would send their patients home with simple advice to walk as much as possible. Specific instructions about how much they should walk every day and at what speed and intensity was given by 42.9% (162/378) of the participants and only 18.3% (69/378) would provide specific instructions asking patients to keep an exercise diary in order to monitor progress. In addition, the majority of the participants in this survey (66.9%) would be interested in using an online coaching platform on monitoring physical activity if SEPs were not available.

Finally, in a subgroup analysis according to the participants' country of origin, it appears that in Europe there is wide variation regarding the availability of SEPs. More specifically in countries like Greece or Spain the availability of SEPs appear to be around 10%. In countries such as Switzerland, Italy, Germany and England, SEPs availability ranges between 35.7 and 46.7% and only in France and the Netherlands is it above 60% with the Dutch surgeons at the top of the list (Table 2). Because of the significant variability in the response rates between the countries, only those countries with more than 9 participants in our survey were included in the analysis (Table 2). Data on health expenditure per percentage of the gross domestic product for these countries ranged between 9.3 and 11.3% (OECD health data; 2009).

### Systematic review on the types and availability of structured, home-based exercise" programs

#### Study characteristics

We identified 12 studies (Table 3) regarding the effectiveness of HEPs on PAD patients who were eligible for inclusion in the analysis

**Table 2**

Availability of supervised exercise programs in selected European countries and healthcare expenditure per country.

Country <sup>a</sup>	Number of participants in the survey	Access (%) to SEPs per country	Healthcare expenditure by %GDP <sup>b</sup>
Netherlands	18	100	11.1
France	9	66.7	11.2
Germany	15	46.7	11.3
Italy	21	38.1	8.9
UK	129	36.4	9.3
Switzerland	14	35.7	11.4
Spain	19	10.5	9.3
Greece	40	10	9.7

<sup>a</sup> Only countries with at least 9 participants in the survey were included in the above table.

<sup>b</sup> OECD health data 2009 (<http://stats.oecd.org/index.aspx>); GDP: Gross domestic product; SEPs: Supervised exercise programmes.

(Fig. 1). From these studies 4 were randomized controlled trials,<sup>10–13</sup> 6 were cohort studies,<sup>14–19</sup> 1 was a non-randomized prospective study<sup>20</sup> and 1 was retrospective.<sup>21</sup> The sample size ranged from a minimum of 29<sup>16</sup> to a maximum of 145 patients<sup>11</sup> and 6 studies recruited more than 100 patients. The follow-up also varied from 3 to 12 months however, in the majority the follow-up was 6 months.<sup>11,13,15,20,21</sup> The main eligibility criterion was the presence of mild or moderate intermittent claudication with a resting ABPI of less than <0.9 with or without a baseline treadmill test.<sup>10–12,14,15,17,19,21</sup>

In the majority of the included studies the HEPs were designed in order to provide patients with easy to follow instructions and specific walking advice according to their baseline functional capacity<sup>10–15,17–19,21</sup> or guided by the pain threshold speed.<sup>16,20</sup> In addition, daily exercise logbooks were provided in 6 studies.<sup>10,16,17,19–21</sup> In 2 studies pedometers were utilized to monitor ambulation<sup>10,12</sup> and in 3 studies the patients were involved in psychological/behavioral interventions.<sup>11,12,21</sup> In 5 of the studies the patients benefited from educational counselling and lectures about PAD.

#### Study outcomes

In 3 of the studies the HEPs (Table 3) were compared with the traditional GHWA,<sup>10,12,20</sup> in 3 other studies the HEPs were compared with SEPs,<sup>10,13,14</sup> in 5 other studies there was only one group of HEP.<sup>16–19,21</sup> Finally there was also one study of SEP but as this occurred in a community setting<sup>15</sup> this was also included since it was not hospital-based activity. In the majority of the studies a treadmill test was used to evaluate the effectiveness of HEPs<sup>10,11,13–21</sup> using claudication onset times,<sup>10,13</sup> initial<sup>15,17,21</sup> and absolute claudication distance,<sup>15,17,20,21</sup> maximum pain free walking distance<sup>14,18</sup> or time,<sup>10,13</sup> maximum speed in one study<sup>16</sup> and pain threshold speed in two studies.<sup>16,20</sup> In 2 other studies pedometers were used to assess the change in the daily ambulation.<sup>10,12</sup> Quality of life (QoL), walking impairment or mental health questionnaires were also used in 7 of the studies,<sup>11,13,14,16,17,19,20</sup> whereas in 5 other studies the ABP index was utilized in combination with the treadmill test.<sup>14,16,18–20</sup>

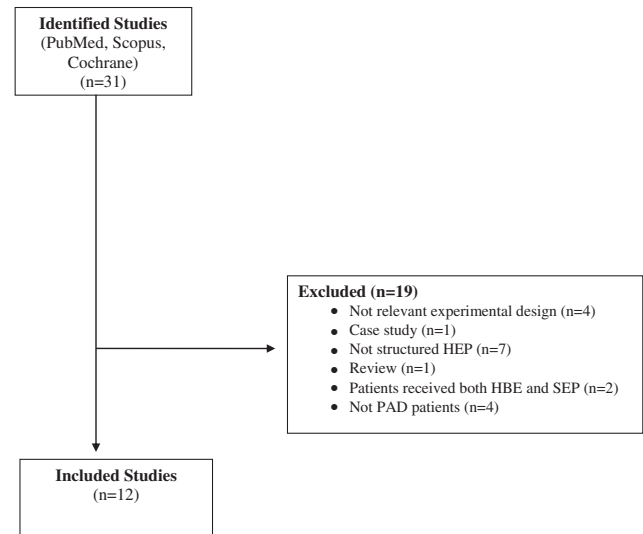
The three studies that compared HEPs with SEPs concluded that SEPs can be superior<sup>14</sup> to HEPs in improving pain free maximum walking distance or equivalent<sup>10</sup> in improving claudication onset times, pain free walking times and QoL measures. However, HEPs could significantly improve all these markers from baseline<sup>10,13,14</sup> and appear superior to SEPs in improving daily ambulation.<sup>10</sup> In all studies that compared HEPs to a GHWA group,<sup>10,12,20</sup> HEPs appeared superior in significantly improving functional capacity and QoL scores.<sup>20</sup> In addition, when the effects of HEPs were

**Table 3**  
Clinical studies evaluating the role of structured home-based exercise in peripheral arterial disease.

Study Author/Year	Design/follow up/no of patients/eligibility criteria	Treatment Modality/HEP description	Changes in the HEP group vs. SEPs or GHWA			Compliance to treatment	Conclusions
			Functional capacity (treadmill tests)	Questionnaires QoL and WIQ	ABPIs/HR/BP		
Gardner et al /2010 <sup>10</sup>	RCT/ 12 wks/ 119pts/IC pts, ABI $\leq$ .90 at rest or ABI $\leq$ 0.73 after exercise	HEP vs. SEP vs. GHWA HEP: Specific exercise advice + step activity monitors + logbooks for monitoring	COT and PWT HEP $\uparrow$ from baseline (S) HEPs = SEPs > GHWA (NS) (S) Daily ambulatory cadences HEP > SEP (S)	–	–	80% completion rates HEP = SEP (S)	HEP using a step activity monitor has high adherence and is efficacious in improving claudication measures similar to an SEP.
Fakhry et al /2011 <sup>14</sup>	Cohort study/12 m/142pts/age over 18, Rutherford category 1, 2, or 3, ABI <0.9 at rest or ABI with a decrease >30% after treadmill test/MPWD <350 m	HEP vs. SEP HEP: Information sheet with specific walking instructions + regular educational sessions around PAD and risk factors	MWD HEP $\uparrow$ by 342% from baseline (S) HEPs < SEPs (S) MPWD HEP $\uparrow$ by 338% from baseline (S) HEPs < SEPs (S)	VascuQoL HEP $\uparrow$ from baseline (S) SF-36 HEP $\uparrow$ from baseline (S) QoL Measures: HEP = SEP	At rest ABPIs HEP (–) from baseline HEP < SEP Post exercise ABPIs HEP $\uparrow$ (S) HEP = SEP	67% completion rates	HEP improved both functional capacity and QoL measures and should be considered as a valuable alternative to SEP.
Manfredini F. et al./2008 <sup>20</sup>	Non-randomized prospective trial/6 m/143pts/IC patients (Fontaine's II stage)	HEP vs. GHWA HEP: specific walking cadence according to max asymptomatic speed using metronome + training logbook-family member to monitor	ACD and PTS $\uparrow$ HEP > GHWE (S)	Improvement of Self-reported claudication HEP > GHWA (S)	ABPIs – HR $\downarrow$ HEP > GHWE (S) SBP $\downarrow$ HEP > GHWA	89.1% completion rates	In PAD patients HEP had more positive effects on perceived claudication and functional and haemodynamic parameters than GHWA
Mouser J et al/ 2009 <sup>21</sup>	Retrospective study/6 m/120pts/ PAD as defined by ABI <0.9	HEP alone HEP: educational session around PAD and risk factors + session with exercise psychologist + exercise logbook	Mean ICD $\uparrow$ from baseline by 86.4% Mean ACD $\uparrow$ from baseline by 19.8%	–	–	34.2% completion rates	Pts improved from baseline with the HEP, but these improvements were less dramatic than those reported in studies of SEP.
Bendermarcher B. et al/2007 <sup>15</sup>	Cohort study/6 m/93pts /IC pts with resting ABI <0.9 and no previous peripheral vascular intervention or amputation	SEP in community setting	Mean ICD $\uparrow$ by 240% Mean ACD $\uparrow$ 191%	–	–	60.2% completion rates	SEPs in the community is a promising form of conservative treatment for patients with IC.
Manfredini F. et al/2004 <sup>16</sup>	Cohort study/120 days/29pts/ pts with stable IC	HEP alone Prescribed walking guided by PTS + exercise logbook	PTS $\uparrow$ and S <sub>max</sub> $\uparrow$ from baseline (S)	Trained group showed symptom reduction up to pain disappearance.	ABI $\uparrow$ from baseline (S) BP $\downarrow$ from baseline (S)	34.4% completion rates	Low cost HEP driven by PTS results in dramatic improvement of functional parameters.
Wullink M et al/2001 <sup>17</sup>	Cohort study/24 wks/31pts/IC pts and ABPI <0.9 at rest or <0.8 after exercise treadmill test	HEP alone Specific walking instructions + Walking logbook + Health counselling	Mean ICD $\uparrow$ from baseline (S) Mean ACD $\uparrow$ from baseline (S) Mean MWD $\uparrow$ from baseline	WIQ $\uparrow$ From 57% (95% CI, 42–71%) to 60% (95% CI, 46–74%)	–	93% completion rates	IC pts improve their average ICD and MWD by participating in a HEP, making this a promising intervention to be tested in an RCT.
Collins T et al/2011 <sup>11</sup>	RCT/6 m/145pts/ pts with diabetes (type I or II) and PAD (ABI<0.9 or toe brachial index < or = 0.7 or prior PAD surgery with IC)	HEPs vs. controls HEP: Behavioural intervention program targeting levels of readiness to engage in routine walking for exercise	MWD HEP = control (NS) Average walking speed HEP $\uparrow$ > controls $\downarrow$ (S)	Mental health QoL subscale score HEP $\uparrow$ > controls $\downarrow$ (S)	–	–	HEP did not improve walking distance but improved walking speed and quality of life in patients

Cunningham M. et al./2012 <sup>12</sup>	RCT/4 m/58pts/newly diagnosed IC pts with post exercise ABPI <0.9	HEP vs. GHWA HEP: Brief psychological intervention at home to modify illness and walking + motivational interviewing + personalized walking action plan + pedometer HEP alone Specific walking advice + Educational counselling around PAD	Planned for intervention HEP < controls (S) Perceived PFWD HEP > controls Mean MPWD↑ by 180% from baseline (S)	Steps/day HEP > controls (S)	—	92.8% completion rates	Brief psychological intervention significantly increased daily walking in patients with IC
Sponk S et al./2003 <sup>18</sup>	Cohort study/4 m/104pts/stable claudication for >3 m (Rutherford stage 1–3)	HEP vs. SEP Weekly exercise instructions + lectures around PAD	COT and PWT ↑ in HEP from baseline (S) HEP < SEP at 6 m (S)	—	Mean ABPIs no change from baseline	70% completion rates	HEPs can provide significant improvement in the MPWD for the majority of patients with IC
Patterson RB et al./1997 <sup>13</sup>	RCT/6 m/55pts/Stable claudication	HEP vs. SEP Weekly exercise instructions + lectures around PAD	—	SF-36 ↑ in HEP from baseline (S) HEP = SEP	—	69% completion rates	Although SEP results in optimal walking benefits, a HEP provides similar functional improvement and may be a good alternative
Roberts AJ et al./2008 <sup>19</sup>	Prospective cohort study/3 m/47pts/Stable claudication >3 m and ABPI <0.9	HEP alone Specific instruction + exercise logbook + phone contact	MWD ↓ in HEP by 76% from baseline (S)	VascuQoL↑ from baseline (S)	ABPIs No change from baseline HR↓ from baseline (S)	Median self reported compliance HEP was 5 h/week	HEP may have beneficial effects on functional parameters and QoL

Abbreviations: HEP: Home based exercise programs, SEP: Supervised exercise program, IC: Intermittent claudication, RCT: Randomised controlled trial, m: months, wks: weeks, pts: patients, MPWD: maximum pain free walking distance, MWD: Maximum Walking Distance, PAD: peripheral arterial disease, WIQ: Walking Impairment Questionnaire ICD: initial claudication distance, ACD: absolute claudication distance, COT: Claudication Onset Time, PWT: Peak Walking Time, PTS: pain threshold speed, S: Statistically significant with  $P < 0.05$ , NS: Non-statistically significant with  $P > 0.05$ , ABPI: Ankle Brachial Pressure index, QoL: Quality of life questionnaires, BP: blood pressure, PFWD: Pain free walking distance, RCT: randomised controlled trials, >: superior, <: inferior, =: equal effectiveness, SF-36: Short form-36.



**Figure 1.** Flow chart of the retrieved and included studies. (PAD: peripheral arterial disease,  $n$  = number, HEP: Home exercised program).

evaluated in comparison to baseline findings, all studies concluded that there was significant improvement in functional capacity and quality of life scores.<sup>16–19,21</sup> Finally compliance rates of HEPs ranged from 34% to 93%, while Gardner et al<sup>10</sup> showed that there was no significant difference between the compliance rates of HEPs and SEPs. There was no data comparing the cost-effectiveness between the two exercise methods.

## Discussion

*SEPs remain an underutilized tool for the management of PAD*

Currently the PAD guidelines suggest that SEPs can be utilized as an initial treatment for patients with claudication and that it should be performed at least 3 times a week, for at least 30–45 min a session and for a total of at least 12 months.<sup>2</sup> There is, though, recent evidence by Gardner et al., suggesting that even 2 months of intensive SEP can be adequate to treat claudication with high adherence rates and lower treatment costs.<sup>22</sup>

According to our international survey less than 1 in 3 vascular surgeons have access to SEPs. In addition, even when there is availability there seems to be a wide variation in the duration of sessions, the total treatment duration and the follow-up. In other words it seems that there is no established SEP modality, which is universally accepted, which questions the quality of service that is provided for the patients with PAD. In addition, when there was no access to SEPs the advice given to claudicants varied significantly. In almost 30% of the participants this was limited to the GHWA which, however, has been associated with poor results.<sup>3,4</sup> Only a minority of physicians (1 in 5) would actually provide specific exercise advice and ask the patients to keep a walking diary in order to monitor the daily physical activity. This lack of a systematic approach to the conservative management of claudicants can hamper the natural rehabilitation of this group of patients.

A recent survey on the availability of SEPs among UK-based vascular surgeons showed that only 24% of them had access to them<sup>9</sup> and that even when there was access there was great variation in their implementation. In another survey performed almost 10 years ago by Cassar et al, it was also shown that accessibility of SEPs was limited to a disappointing 34% of the participating British vascular surgeons.<sup>23</sup> In our survey the majority of participants came

from the UK (129 surgeons). Only a 36.4% of them had access to SEPs showing that no significant progress has since been made in the UK. This lack of progress can be attributed to funding issues, as well as to the lack of a clear, standardised SEP protocol that would be universally accepted.

For the remainder of Europe and for those countries where sufficient data was available, the average SEP's availability appears to remain small with only France and Netherlands being above 60%. Greece and Spain appear to perform worse with about 10% availability rates and with the remaining countries ranging between 30 and 40% (Table 2). If the healthcare expenditure for each country is taken into consideration, as shown in Table 2 (OECD health data 2009), the differences in this budget are insufficient to explain the cause of such a wide variation in the availability of this important service. Interestingly, the healthcare expenditure by percentage of GDP only ranges between 9.3 and 11.3% whereas the variation in SEPs availability is much greater at 10–100%.

Since the majority of responses came from European surgeons it would not be realistic to extrapolate the above results regarding the current practice outside this region. In addition, the rather small return rate from some countries did not allow us to reach definitive conclusions about the true availability in order to make meaningful comparisons. Another limiting factor is the lack of similar international surveys in the past which precluded comparisons on improvements within the European continent. Finally, it is possible that since we contacted vascular surgeons rather than institutions, institutional access to supervised exercise may have been over- or underestimated by an uneven distribution of responding surgeons. A larger international survey is necessary in order to evaluate the exact availability of SEPs, as well as the reasons behind the lack of their widespread implementation.

#### *The emergence of structured HEPs and their role*

Structured, home-based or community-based exercise programs could bridge the gap between the highly structured and costly SEPs and the non-structured, non-supervised but inexpensive GHWA. A recent Cochrane meta-analysis demonstrated that SEPs have clinically relevant benefits compared with non-supervised, unstructured exercise programs.<sup>3</sup> Eight randomized controlled trials were included comparing the two treatment options. Six compared SEPs with GHWA and the remaining two compared SEPs with GHWA combined with an additional weekly phone contact for support. Despite the comparison of a highly structured treatment modality such as the SEPs with a completely unstructured and unsupervised modality, the net benefit for the patients who participated in the SEPs was translated into a 150 m increase in their walking distance. There was no evidence of any effect on quality of life. The effect of structured HEP might be pronounced due to their improved systematic approach in comparison to the simple GHWA. The HEPs encourage patients to integrate exercise into their daily routine rather than committing to the artificial environment of a SEP class. The latter may directly affect compliance and the long-term adherence to a more active life style. The possibility of a more sustainable effect may explain why some studies have shown that HEPs could be equivalent or even superior to SEPs.<sup>10</sup>

The main objective of this systematic review was to identify studies that compare the effectiveness of structured forms of HEPs with SEPs. Only three such studies<sup>10,13,14</sup> were identified which showed that while SEPs were superior in improving some markers of functional capacity there were also other markers such as daily ambulation, claudication onset time, pain-free walking time or the QoL scores where the HEPs could be equivalent or sometimes even superior to SEPs. This was explained by the possibility of a more sustainable effect.<sup>10</sup> In addition, studies were identified suggesting that HEPs performed better than the random GHWA in improving

functional capacity and quality of life when compared to controls or baseline measurements.<sup>10,12,20</sup> Despite the limited number of studies, the lack of large multicentre, randomised trials, the heterogeneity between the outcomes and design and the possibility of publication bias, there is significant, preliminary evidence to suggest that structured HEPs can be an effective approach when SEPs are not available. Further research is warranted in order to establish the cost-effectiveness of this approach as well as long-term results.

#### *The use of pedometers and online coaching to increase motivation*

Simple and effective ways to monitor and increase physical activity are available without the need for costly hospital-based interventions.<sup>24</sup> The use of pedometers, for example, may increase physical activity and improve quality of life as it was shown in a recent meta-analysis.<sup>25</sup> This review by Bravata et al (26 studies, 2767 participants) showed that the use of pedometers significantly improved physical activity by more than 2000 steps per day which was combined with improvements in body mass index and blood pressure. Despite the lack of patients with PAD from this study the message on the improvement possibilities with a pedometer are clear and encouraging.

Pedometers are a simple way to track activity and motivate people to avoid a sedentary life style. The widespread use of personal computers and smartphones has facilitated the combination of specially designed pedometers with online coaching platforms. This has revolutionised the way people exercise and control their weight by providing them with a digital personal trainer. Activity is monitored through the pedometer and advice and motivation can be delivered via email alerts or text messages.<sup>26</sup> Currently, the use of online coaching and digital pedometers would probably suit younger patients of higher socioeconomic status, though, this is subject to change due to the rapid spread of affordable, computer technology and web services. In view of this prospect, more research is needed to support the combination of pedometers with online coaching as a motivational tool in PAD patients. However, until more evidence is available, simple and inexpensive interventions such as leaflets with specific walking advice, pedometers and walking logbooks should be available from the PAD clinics.

#### **Conclusion**

Despite the accumulating evidence on the effectiveness of SEPs for the management of PAD, it appears that they largely remain an underutilized tool. The implementation of alternative approaches for the management of PAD, such as structured, home-based programs is a feasible approach that may combine the benefits of the SEPs' monitored environment with the low cost and convenience of a home-based modality. The preliminary results are promising and support the effectiveness of structured HEPs to increase functional capacity and improve quality of life when SEPs are not available. More randomized trials are needed to establish the cost-effectiveness and the long-term results of this approach.

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None.

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