Baseline Characteristics

A total of 256 patients were included, 128 belonged to the control group (CG) and 128 to the intervention group (IG). During the first stage, Phase II of the cardiac rehabilitation program (CRP), 16 patients dropped-out of the study, 10 in the CG and 6 in the IG. The reasons are specified in Figure 1. One patient in the IG had an episode of angina and it was decided to continue the face-to-face CRP, and one patient in the CG also had angina, which required a new coronary revascularisation. One CG patient had to undergo surgery for a renal tumour. In the remaining cases, dropouts were due to family problems (2 CG patients), which prevented them from attending the programme, work incompatibility (1 IG patient and 3 CG patients), two IG patients preferred, after randomisation, to do the face-to-face CRP, and 3 CG patients finally decided not to do the face-to-face CRP. Two IG patients disappeared with the equipment.

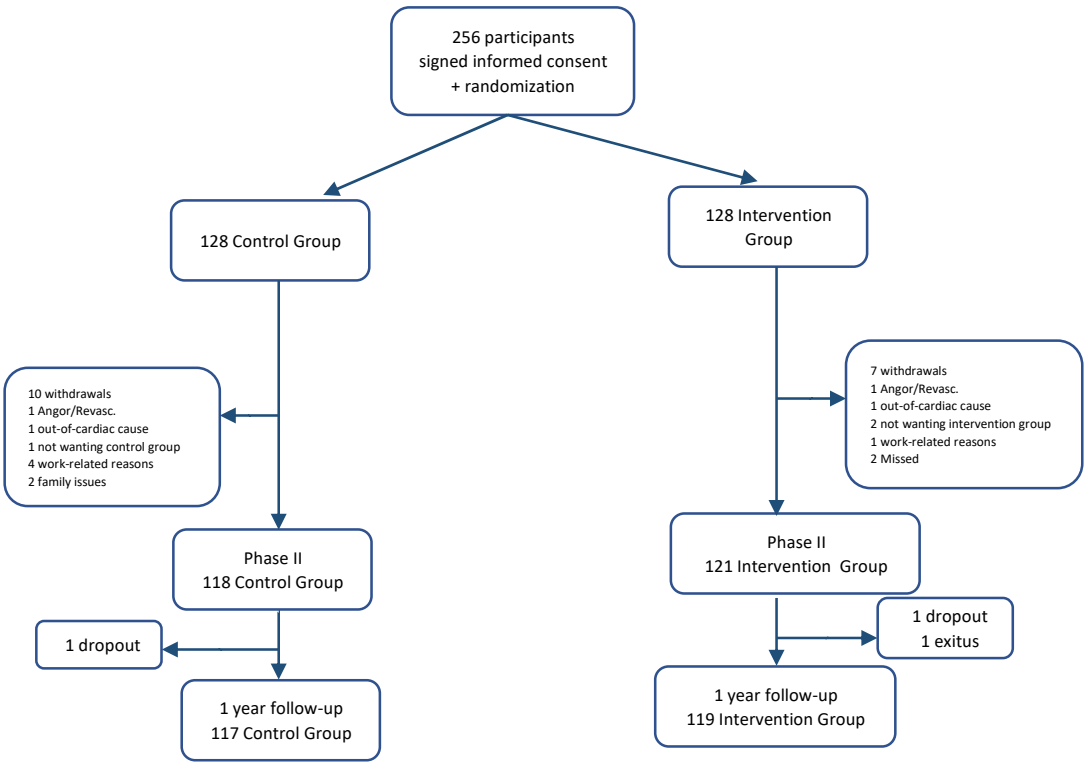

Figure 1. Participants Flow diagram

The baseline characteristics of both groups were analysed (*Table 1*), and no significant differences were found with respect to diagnosis, age, sex, baseline functional capacity, risk factors, psychosocial characteristics, except for family history of ischaemic heart disease, which was slightly lower in the IG group, and statin treatment. This difference may be related, at least in part, to the higher (but not significant) number of patients with valvular heart disease in the IG.

Table 1. Baseline characteristics of participants

Variable	Control Group	Intervention Group	p
Sex (% males)	86.7	87.5	0.852
Age (years)(mean±SD)	55.8 ± 10.7	55.8 ± 10.3	0.974
Ischaemic heart disease (%)	95.3	93.0	0.425
Stable angina (%)	5.9	9.2	0.336
Valvular heart disease (%)	3.9	7.8	0.189
FEVI (mean ± SD)	61.3 ± 6.8	61.5 ± 5.6	0.819
Stroke (%)	0.9	0.9	0.981
Arteriopatía periférica (%)	3.6	0.9	0.160
Smoking (%)	-	-	0.363
Non-smoker	35.2	35.2	-
Smoker	29.7	22.7	-
Former	35.2	45.2	-
HBP (%)	41.4	43.0	0.800
DM (%)	10.9	12.5	0.698
Dyslipidemia (%)	69.5	68.5	0.859
Family history (%)	22.6	12.1	0.043
Physical exercise (%)	65.6	65.9	0.964
Alcohol consumption (%)	51.3	45.9	0.405
BMI (kg/m2)(mean ± SD)	27.5 ± 4.0	27.9 ± 4.1	0.347
abdominal girth (cm) (mean)	99.3	100.7	0.326
Creatinine (mg/dl)(mean ± SD)	0.88 ± 0.2	0.88 ± 0.2	0.874
HDL (mg/dl) (mean ± SD)	40.4 ± 10.9	40.9 ± 11.7	0.752
LDL (mg/dl) (mean ± SD)	109.8 ± 38.6	104.0 ± 36.7	0.233
HbA1c (%)(mean ± SD)	5.7 ± 0.6	6.0 ± 1.2	0.120
METS (mean)	8.0	8.0	0.994
AFR (%)(mean ± SD)	13.4 ± 13.7	12.8 ± 16.9	0.757
Beta-blocker (%)	82.8	73.4	0.070
ACE inhibitors or Sartans (%)	71.1	61.7	0.112
Calcium antagonist (%)	8.6	8.6	>0.99
Antiaggregant (%)	94.1	94.5	>0.99
Anticoagulant (%)	5.5	8.6	0.328
Aldosterone Antagonists (%)	2.3	2.3	>0.99
Estatins (%)	98.4	89.1	0.002
Diuretics (%)	3.9	10.2	0.051
EQ-5D State (median)	5	5	0.367
EQ-5D Health (median)	80	75	0.116
STAI Trait (median)	25	37.5	0.205
STAI State (median)	40	45	0.757
BDI (median)	5	5	0.777
SHIM (median)**	21	21	0.949
BDHI Total (median)	27	26	0.707
Sleep quality (median)	5	5	0.720
Employment status (%) Active Unemployed Retiree by age Early retiree Incapacity due to heart disease Incapacity due to other cause	 70.3 8.6 15.6 4.7 0 0.8	 66.4 8.6 18.0 5.5 0.8 0.8	0.921
Kind of job (%) Manual freelance Manual no freelance White-collar freelance White-collar no freelance	 5.7 25.8 13.7 54.0	 7.9 29.9 6.3 54.3	0.330

Variable	Control Group	Intervention Group	p
Housekeeper	0.8	1.6	
Educational level (%)			
Primary	12.8	19.4	
Secondary	48.8	45.2	0.371
Higher education	38.4	38.5	
Marital status (%)			
Single	11.0	6.4	
Married	79.5	84.0	0.593
Widow(er)	3.2	2.4	
Divorced	6.3	7.2	

*t student for continuous variables; Z test for rates and chi2 categorical variables. AFR: aerobic functional reduction. SHIM: The Sexual Health Inventory for Men. **Males only.

CG patients attended an average of 17.1±2 face-to-face physical training sessions at the Cardiac Rehabilitation Unit (CRU) of the Hospital Universitario Ramón y Cajal (95% adherence). Face-to-face relaxation sessions were 16.3±4 (90.5% adherence), and attendance at educational talks was 8.1±0.6 (90%).

IG sessions and adherence are described in *Table 2*. For the IG patients, 45 walking sessions were planned during the intervention period, of which they attended 43.8±1 (adherence 97.3±3). In relation to the relaxation sessions, 35 were scheduled, of which 31.7±1 were carried out (adherence 90.6±4%). As an equivalent to the educational talks, an average of 32.9±6 were recommended (variations according to patient profile as the plan is personalised), of which 34.5±1 were completed (adherence 95.4±15.6).

Table 2. IG protocol adherence

Concept (per participant)	Walking	Relaxation	Educational videos
Planned	45	35	32.91±5.56
Done	43.81 ± 12.94	31.72 ± 14.75	34.50 ± 1.33
Global adherence	97.35 ± 30.97	90.63 ± 42.14	95.36 ± 15.57
Male adherence	97.73 ± 31.16	89.00 ± 43.27	-
Female adherence	94.81 ± 30.57	101.52 ± 32.82	-

ANALYSIS AT THE END OF THE CARDIAC REHABILITATION PROGRAMME (PHASE II).

Primary objective

The main analysis was designed to assess whether the 'e-supervised regime' CRP is non-inferior to the traditional 'supervised regime' rehabilitation programme in terms of functional capacity gain in METs (metabolic equivalent) measured by ergometry (ramp protocol) at the end of stage 1. A difference of no more than one METs is considered a non-inferiority limit.

When analysing the results, it was found that, although the improvement in functional capacity is somewhat higher in the IG, the 'e-supervised regime' (IG) CRP is non-inferior ($p<0.0001$) to the traditional 'supervised regime' CRP in terms of functional capacity gain (*Table 3*). All analyses all the analyses were made by intention-to-treat.

Table 3. MET gain at final visit Phase II

	IG (IC al 95%)	CG (IC al 95%)	Difference between groups	p* non inferiority
MET gain	1.23 (1.0; 1.47)	0.89 (0.73; 1.04)	0.35 (0.06; 0.68)	< 0.001

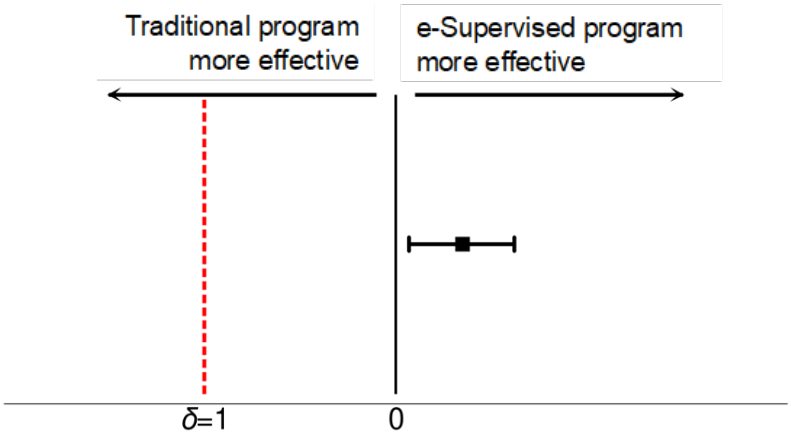

Figure 2. Effectiveness at non-inferiority analysis

Conclusion: The 'e-supervised' CRP is non-inferior to the traditional 'supervised' rehabilitation programme in terms of functional capacity gain (Figure 2).

Secondary objectives

The different variables were compared with conventional bilateral analysis as no non-inferiority limit was established (*Table 4*). No significant differences were found when comparing the results at the end of Phase II of the CRP between the CG and the IG with respect to: complications, control of risk factors: smoking cessation ($p = 0.895$), HBP control ($p = 0.600$); diabetes control ($p = 0.201$); dyslipidaemia control ($p = 0.874$), quality of life (EQ-5D) ($p = 0.185$), anxiety levels (STAI State and Trait) ($p = 0.501$ and $p = 0.185$), anxiety levels (STAI State and Trait) ($p = 0.501$ and $p = 0.304$), depression (Beck Inventory) ($p = 0.895$), sleep quality ($p = 0.642$), exercise adherence ($p = 0.088$) and medication: beta-blockers ($p = 0.882$), ACE inhibitors or

Sartans (p = 0.624), antiplatelet (p = 0.762), anticoagulants (p = 0.842), statins (p = 0.538), at discharge from Phase II (*Table 4*).

There was one cardiological complication in each group: an acute coronary syndrome without persistent ST segment elevation (NSTEMI) requiring percutaneous revascularisation with stenting. And one non-cardiological complication: one patient required inguinal hernia surgery and one patient dropped out of the study after diagnosis of a renal tumour.

During this Phase II there were also 8 dropouts in the CG and 5 in the GI. The causes are specified in Figure 1.

Table 4. Secondary variable results at the end of Phase II

Variable	CG	IG	p
Take recommended exercise (%)	99.2	95.6	0.088
Active smoking (%)	6.2	5.8	0.895
Controlled HBP (%)	85.4	88.9	0.600
Controlled DM (%)	61.5	82.4	0.201
Controlled dyslipidaemia (%)	55.7	54.5	0.874
BMI (kg/m2)(mean ± SD)	27.4 ± 4.1	27.0 ± 3.5	0.396
Abdominal girth (cm)(mean ± SD)	99 ± 11	98 ± 10	0.266
LDL (mg/dl)(mean ± SD)	77 ± 24	76 ± 24	0.678
Hb1Ac (%)(mean ± SD)	5.8 ± 0.7	5.9 ± 0.9	0.707
EQ5D State change (median (IQR))	0 (IQR=1)	0 (IQR=0)	0.185
EQ5D Health change (median (IQR))	6.5 (IQR=11)	5 (IQR=10)	0.280
STAI Trait change (median (IQR))	-4 (15)	-3 (26)	0.501
STAI State change (median (IQR))	-10 (30)	-5 (29)	0.304
BDI change (median (IQR))	-1 (4)	-1 (3)	0.895
SHIM** change (median (IQR))	0 (3)	0 (2)	0.767
Sleep change (median (IQR))	0 (3)	0 (3)	0.642
Beta-blockers (%)	74.6	75.4	0.882
ACE inhibitors or Sartans (%)	66.9	64.0	0.624
Calcium antagonist (%)	10.2	8.2	0.597
Antiaggregant (%)	89.8	90.1	0.762
Anticoagulant (%)	5.9	6.6	0.842
Aldosterone Antagonists (%)	0	0.8	0.324
Estatins (%)	93.2	95.1	0.538
Diuretic (%)	3.4	7.4	0.173

*Student's t-test for continuous variables; Z-test for proportions and chi2 for categorical variables and Wilcoxon U-test. **Male only; SHIM: The Sexual Health Inventory for Men; BMI: body mass index; DM: diabetes; HBP: hypertension; IQR: Interquartile range; SD: Standard deviation. ACE: angiotensin-converting enzyme.

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Finally, the results obtained one year after discharge from Phase II of the cardiac rehabilitation programme were analysed.

In this year there were 3 dropouts: one IG patient died of pancreatic neoplasia, and two patients, one from each group, could not be located.

We analysed the data of 117 CG patients and 119 IG patients.

Taking these assumptions into account, we observed again that the 'e-supervised' cardiac rehabilitation programme is non-inferior to the traditional 'supervised' rehabilitation programme in terms of gain - maintenance of functional capacity, when comparing the first visit to the one-year visit (*Table 5*, Figure 3).

Table 5. MET gain on final visit

	Intervention Group (95%CI)	Control Group (95%CI)	Difference between groups (95%CI)	p non inferiority
Gain in functional capacity (MET)	1.49 (1.23; 1.76)	2.03 (1.69; 2.36)	-0.53 (-0.96; -0.10)	0.016

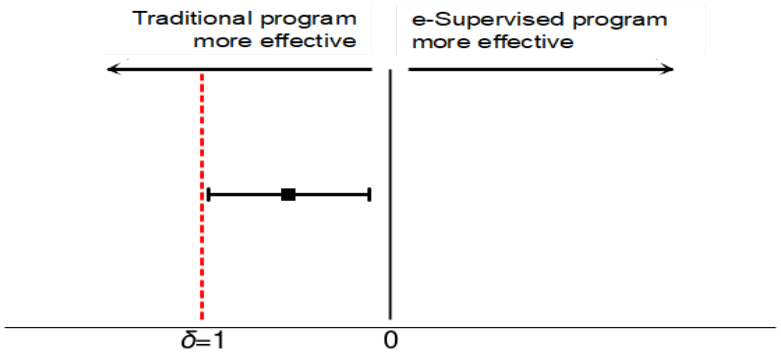

Figure 3. Effectiveness at non-inferiority analysis. 1-year follow-up.

Conclusion: The 'e-supervised' cardiac rehabilitation programme is non-inferior to the traditional 'supervised' rehabilitation programme in terms of functional capacity gain at the end of follow-up.

Secondary objectives

The secondary objectives were compared with conventional bilateral analysis, and showed no significant differences in: regular physical exercise (p=0.554), control of risk factors: smoking (p=0.536), HBP (p=0.703), diabetes (p=0.983) and dyslipidaemia (p=0. 666); in levels of state anxiety (p=0.125), depression (p=0.585), quality of life (EQ-5D State p=0.202), quality of sleep (p=0.409) and pharmacological treatment (*Table 6*).

Table 6. Secondary variables result at 1-year follow-up

Variable	Control Group	Intervention Group	p*
Take recommended exercise (%)	93.8	91.7	0.554
HBP (%)	91.1	88.9	0.703
Controlled DM (%)	68.6	68.4	0.983
Controlled dyslipidaemia (%)	76.2	78.8	0.666
Active smoking (%)	7.1	5.2	0.536
AC (cm ± SD)	97 (9)	97 (10)	0.798
BMI (kg/m2 ± SD)	27.0 (3.6)	27.1 (3.7)	0.808
LDL (mg/dl ± SD)	71 (24)	70 (19)	0.546

Variable	Control Group	Intervention Group	p*
Hb1Ac (% ± SD)	5.8 (0.7)	5.9 (0.8)	0.866
EQ5D State (Md)	5 (IQR = 0)	5 (IQR = 1)	0.202
EQ5D Health	85 (IQR = 10)	85 (IQR = 15)	0.074
STAI Trait	40 (IQR = 24)	40 (IQR = 27)	0.434
STAI State	38 (IQR = 30)	33.5 (IQR = 17.5)	0.127
BDI	3 (IQR = 6)	3 (IQR = 6)	0.485
SHIM**	22 (IQR = 5)	22.5 (IQR = 8)	0.915
Sleep	3 (IQR = 4)	4 (IQR = 4)	0.409
Beta-blockers (%)	74.4	66.7	0.194
ACE inhibitors or Sartans (%)	61.5	56.7	0.446
Calcium antagonist (%)	12.8	10.8	0.636
Antiaggregant (%)	88.9	90.0	0.781
Anticoagulant (%)	5.1	3.3	0.492
Aldosterone Antagonists (%)	0	0.8	0.322
Estatins (%)	94.0	93.3	0.829
Diuretic (%)	6.0	12.5	0.084
Ezetimibe (%)	27.4	33.3	0.317

*Student's t-test for continuous variables; Z-test for proportions and chi2 for categorical variables and Wilcoxon U-test;

**Only males; SHIM: The Sexual Health Inventory for Men; BMI: body mass index; BMI: body mass index; DL: dyslipidaemia; DM: diabetes; HBP: high blood pressure; Md: median; IQR: Interquartile range; AC: abdominal circumference.

Safety

In the year of follow-up, one IG patient died of an extracardiac cause (pancreatic neoplasia). Eight CG and 5 IG patients were admitted to hospital for cardiological causes. Two patients in each group presented with an NSTEMI, requiring percutaneous coronary revascularisation. Three CG and two IG patients were admitted to hospital for chest pain, with no evidence of new coronary lesions on coronary angiography (*Table 7*).

Table 7. Complications at one-year follow-up

Complications	CG	IG	
NSTEMI	2	2	NSS
Atrial flutter ablation	1	1	NSS
Myopericarditis	1		NSS
Vasospastic angina	1		NSS
CP. no coronary injuries	3	2	NSS

NSTEMI: acute coronary syndrome without persistent ST segment elevation; CP: chest pain; CG: control group; IG: intervention group; NSS: not statistical significance.

Platform & Services

As a final component of the evaluation, the results corresponding to feasibility, usability and satisfaction with the e-service are presented. The results shown correspond to 115 IG patients who at the time of data extraction had completed Phase II.

Table 8 shows the distribution by sex (100 men) and age (57.3 ± 9 years). The total number of days the service was operational was 1087 (cumulative days 7281) with 6.7 simultaneous patients on average. Each patient stayed an average of 63.3 days.

Table 8. Information about intervention group

Concept	Quantity
Total participants	115
Men	100
Women	15
Age	57.33 ± 9.19
Men	56.66 ± 8.93
Women	61.87 ± 16.60
Number of study days	1,087
Total accumulated days	7,281
No. Days/Patient	63.31 ± 12.91
Average no. of simultaneous patients	6.70

Regarding the telemonitored therapeutic activities (walking sessions and relaxation sessions), and their associated tools/services (walking app and relaxation app), the results were as follows: For the walking sessions (*Table 9*), a total of 4912 sessions were carried out, of which 4564 (92.9%) were completed; 348 (7%) were cancelled, of which 186 (4%) were reported to have a technical cause.

Table 9. Walking session. Sites

Type	No. Sessions	No. Sessions Terminated	Cancelled	Technical cause
Walking sessions	4912	4564 (92.92 %)	348 (7.08 %)	186 (4.08 %)
Stroll	112	112 (100%)	0 (0 %)	0 (0 %)
Rest	28	-	-	-

With regard to the completed walking sessions (*Table 10*), patients managed to stay 76% of the time within the recommended therapeutic training range. On average, the sessions lasted 1h with a calorie consumption of 338 calories and a distance of 5.7 km.

Table 10. Terminated walking sessions:

Duration (min) (mean ± SD)	Distance (km) (mean ± SD)	% time in range* (mean ± SD)	Recovery (bpm) (mean ± SD)	Calories (mean ± SD)
58.51 ± 3.04	5.72 ± 1.6	76.42 ± 26.21	-5.98 ± 6.65	338.32 ± 121.5

*Percentage of time during which HR was within the personalised training range. min: minutes; km: kilometres; bpm: beats per minute.

Regarding relaxation sessions (*Table 11*), 3648 sessions were held, of which 2468 (67%) were guided and 1180 (32%) were unguided (music only).

Table 11. Relaxation sessions. Type.

Type	No. Sessions	Percentage of total sessions (% of guided sessions)
Guided sessions	2468	67.65
Diaphragmatic	702	19.24 (28.44)
Muscular	354	9.70 (14.34)
Imagination	452	12.39 (18.31)
Short codes	490	13.43 (19.85)
Mixed	470	12.88 (19.04)
Non-guided sessions (music only)	1180	32.35

The length of the relaxation sessions was approximately 30 minutes (*Table 12*).

Table 12. Relaxation sessions. Length.

Item	Length (min)	Final HR - Basal HR (bpm)	Minimum HR - Basal HR (bpm)
Totals			
Guided sessions	35.50 ± 9.41	-3.01 ± 10.75	-10.84 ± 7.79
Non-guided sessions	28.32 ± 9.50	-0.88 ± 8.73	-8.34 ± 5.55

In relation to the virtual meeting services/tools, the results were as follows: For the web messaging service (asynchronous), 3876 messages were exchanged; 33.7 messages per patient (*Table 13*). As on average there were 6.7 patients simultaneously doing the e-supervised phase II, it implies that each patient sent approximately 1 message every two days.

Table 13. Use of messaging services

Concept	Amount
Total messages	3876
Total messages / day*	3.57
Total messages / patient	33.70
Messages / day / patient	0.53

* number of concurrent patients: 6.70

Table 14 shows the distribution of messages in each of the established topic.

Table 14. Messages by topic

Topic	No. Messages	Percentage
General	1605	41.41
Food	49	1.26
Cardiology	507	13.08
Exercise	468	12.07
Medication	48	1.24
Psychology	373	9.62
Socio-labour	29	0.75
Technical support	291	7.51
Private	506	13.05

Regarding training programmes and multimedia resources, each patient has reviewed 34.5 videos and they have been scored above 4 points (maximum of 5) (*Table 15*).

Table 15. Training videos

Topic (no. videos)	Visualizations	Score
Totals per Patient	34.50 ± 1.33	4.30 ± 0.5
What is Cardiac rehabilitation (1)	116	4.10 ± 0.0
Heart diseases (3)	225	4.81 ± 0.2
Diagnostic and therapeutic tests (1)	114	4.43 ± 0.0
Atherosclerosis and risk factors (6)	609	4.10 ± 0.4
Dietary modifications (3)	335	4.49 ± 0.2
Drugs (2)	117	4.52 ± 0.2
Regular exercise and its benefits (3)	339	4.25 ± 0.1
How to train (6)	614	4.30 ± 0.1
Psychological intervention (9)	974	4.27 ± 0.1
Relaxation (2)	226	4.32 ± 0.1
Back to work and social factors (1)	44	3.98 ± 0.0
Sexual disturbances (1)	98	4.29 ± 0.0

To assess the usability of the walking and relaxation applications and the web platform, the SUS (System Usability Scale) questionnaire was used, the scores of which are shown in *Table 16*. Global usability was subdivided into the usability and learnability component.

Table 16. Usability Questionnaire (SUS)

Item	SUS (global)	Usability	Learnability
App	87.7	87.7	87.9
Web	86.2	85.9	87.3