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# Evolution of depression during rehabilitation program in patients with cardiovascular diseases

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## ABSTRACT

**Background:** Cardiovascular diseases represent the main cause of death in the world. Rehabilitation through exercise is more and more used in cardiac patients. Given that these patients suffer from depressive symptoms, the risk of having recurrent cardiovascular problems increases. Thus, the aim of this study is to identify the effects of a rehabilitation program on the physiological and psychological parameters; with a particular attention on the depression scores between the scales.

**Methods:** Twenty-eight cardiac patients participated in this study during a cardiovascular rehabilitation program. They are tested at their entry and at their exit with an evaluation of their physical fitness on an electromagnetic cycle ergometer and by four depression scales (Beck Depression Inventory, Hospital Anxiety and Depression Scale (HADS), Center for Epidemiologic Studies – Depression and Geriatric Depression Screening).

**Results:** We observe that 21.4–50% of these patients have depressive symptoms, according to depression scales. The women have depression scores significantly higher than the men. The rehabilitation program improves their maximal oxygen consumption and their maximal aerobic power. At the end of the rehabilitation program, our analysis identifies a significant decrease in the depression score for the HADS. Regardless of the physical deconditioning level and of the improvement of the maximal oxygen consumption, our results show an effect of the rehabilitation program on the depression scores. No correlation between the physical deconditioning and the different depression scores is observed.

**Conclusions:** This study shows the importance of measuring depression and its severity to improve the care of patients. Our findings show that between 21.4% and 50% of patients have depressive symptoms which challenges the categorical approach of the self-report depression scales.

## ► IMPLICATIONS FOR REHABILITATION

- Depression and cardiovascular diseases have an impact on the patients' physical fitness.
- The rehabilitation program, primarily based around exercise, reduces depressive symptoms.
- As soon as cardiovascular diseases patients enter in a rehabilitation program, the depression should be measured by a psychologist.
- Taking into account the depressive symptoms of the patients as soon as their cardiac event occurs makes it possible to improve the care of patients.

## Introduction

Cardiovascular diseases (CVDs) represent the main cause of death in the world with 17.5 million deaths each year (31% of global mortality) [1]. In Europe, recent data suggest that about half of the deaths are due to CVDs, with almost 4 million of people dying each year [2]. The CVDs are favored by a sedentary population [3] and by the presence of multiple cardiovascular risk factors (i.e., hypertension, obesity, overweight, dyslipidemia, diabetes, smoking, depression) [4].

Depression is an important psychological factor to predict mortality [5] and is known to be associated with CVDs [6,7]. Indeed, depression and anxiety are predictors of coronary heart disease

[6] and of infarcts [7]. Also, depression is a consequence of CVDs since the patients may suffer from a depressive disorder or a severe depression after the development of a heart disease [8,9]. Seldenrijk et al. show, in currently depressive patients, a dose–response association between symptom severity and CVDs with a risk of two-fold in a follow-up period of six years [10]. A meta-analysis shows that patients with both depressive symptoms and CVDs have a higher risk of having recurrent cardiovascular problems than patients who have no depressive symptoms [11]. In those with depression without CVDs, physical exercise is associated with a reduction of depressive symptoms [12], which is also observed in depressive patients with CVDs [13,14]. The physical

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mechanisms underlying the antidepressant effects of physical activity is in the state of assumptions [12]. Indeed, several physiological and psychological mechanisms of the body could explain the relationship between physical activity and depression (thermogenic hypothesis, endorphin hypothesis, monoamine hypothesis, distraction hypothesis).

Another significant factor in the prognostic of patients with CVDs is their physical fitness [3]. Depression and anxiety are predictors of physical decline in patients with heart failure [15]. Thus, the care of patients has evolved in recent years by integrating physical activity in cardiovascular rehabilitation programs [16,17]. Physical activity has been consistently associated with a reduced risk of CVDs [18], a means of prevention against depression [14] and a treatment of depression [19]. Current clinical recommendations include the screening and treating of depression as the “standard of care” for the patient to avoid re-hospitalization within the first 6 months [20]. This is important because the symptoms associated with depression such as fatigue, lack of energy, loss of appetite, sleep problems, psychomotor and attention problems are also associated with a poor prognosis for CVDs outcomes [21].

Several depression scales are used to assess depressive symptoms in patients with CVDs [22,23], allowing the observation of a prevalence depression in people with a heart disease of about 30% [22]. However, the prevalence of depression is variable within the same scale [24,25]. The aim of this study is to identify the effects of a rehabilitation program on the physiological and psychological parameters of CVDs patients; with a particular attention on the depression scores between the scales. Therefore, the first hypothesis is that patients with CVDs will have high depression scores that will differ according to the scales used, while the second hypothesis is that the rehabilitation program will improve the depression score.

## Methods

### Participants

It is a retrospective study where all data are collected in May 2008. Informed consent is obtained from participants. This investigation is conducted in accordance to the World Medical Association Declaration of Helsinki, and is depended upon country rules (law n°2004-806; CCTIR 24 October 2005). A total of 28 cardiac patients (22 men and six women) participate in this study consisting of an ambulant cardiovascular rehabilitation program of 4 weeks. The inclusion criteria are all patients with coronary, infarct, heart failure or valvulopathy, whereas the exclusion criteria are applied when the patients are under 18 years old or have a chronic lower respiratory disease. All patients are tested at their entry (time 1) and at their exit (time 2) with at each moment, an evaluation of the physical fitness by an exercise stress test on ergocycle. The patients complete four depression scales. Between time 1 and time 2, they follow a rehabilitation program.

### Exercise stress test

All patients perform an exercise stress test at their entry and at their exit of the rehabilitation program; the tests are performed on an electromagnetic cycle ergometer (Ergoline 900; Bunnik, The Netherlands). A cardiopulmonary exercise test combined with a breath-by-breath combined exercise metabolic and cardiac system (CardiO2; Medical Graphic Corp, St Paul, MN) allows measuring of the maximal aerobic power (MAP) and the maximal oxygen consumption ( $\dot{V}O_2$  peak). The exercise stress test is composed of a

warm-up at 20% of the predetermined maximal load followed by an increment of 10 W per minute.

### Depression scales

The depression scales enable measuring of the depressive symptoms in cardiac patients. This study examines the main depression scales of the scientific literature and especially those studied in the works of Yohannes and Delville [22,23].

- The Beck Depression Inventory (BDI) is used to measure depressive symptoms [26]. It has excellent psychometric properties with Cronbach's alpha coefficient of 0.93 and retests Pearson's *r* of 0.93. The BDI is a 21-item multiple-choice self-report inventory for measuring the severity of depression. Statements are reported on a four-points scale ranging from 0 (not at all) to 3 (very much so) in terms of severity; the total score range is of 0–63. All patients are categorized into four groups of depressive symptoms based on standard clinical categories for the BDI. The patients with a score of 0–13 are categorized as having no depressive symptoms, 14–19 as mild, 20–28 as moderate and 29–63 as having severe depressive symptoms [27].
- The Hospital Anxiety and Depression Scale (HADS) is used to identify patients with a clinically significant anxiety and depression [28]. The HADS is widely recommended as the screening tool in the cardiac setting [29]. It has excellent psychometric properties with Cronbach's alpha coefficient of 0.85 and Pearson's *r* of 0.73. This depression scale is composed of two subscales: an anxiety scale (HADS-A) and a depression scale (HADS-D). Each subscale includes seven-item rated on a four points scale (0–3); a high score indicates more symptoms. Scores for each subscale (anxiety and depression) range from 0 to 21 with scores categorized as follows: no anxiety and depression 0–7, anxiety and depressive disorders 8–10, severe anxiety and depression 11–21.
- The Center for Epidemiologic Studies – Depression (CES-D) is designed to identify depression among the general population [30]. It has excellent psychometric properties with Cronbach's alpha coefficient of 0.85 and Pearson's *r* of 0.70. The CES-D is composed of 20-item, which evaluate various aspects of depressive symptoms: depressed mood, feelings of guilt, hopelessness, psychomotor retardation, anorexia and sleep disorders, according to the previous week. Each answer is rated from 0 (never, rarely – less than a day) to 3 (often, all time – 5–7 days) depending on the frequency of symptoms. A score higher than 17 for men and 23 for women is indicative of depressive disorders.
- The Geriatric Depression Screening (GDS) uses a 30-item self-report assessment designed to identify geriatric depression [31]. The patients can answer yes or no to the questions depending on the state in which they felt during the previous week. A positive response to 20 of the 30 questions and a negative response to the 10 other questions (1, 5, 7, 9, 15, 19, 21, 27, 29, and 30) suggests a possible presence of depression. A score of 0–10 is represented by the absence of depression, 11–20 by a mild depression and 21–30 by a moderate to severe depression. It has excellent psychometric properties with Cronbach's alpha coefficient of 0.94 and Pearson's *r* of 0.85.

### Rehabilitation program

The rehabilitation program is especially based around exercise where all patients, within a group, perform exercise training

during 4 weeks with 5–6 training sessions per week. Each training session is composed of 30–45 min on a stationary electro-magnetic bicycle with a 5-min warm-up at 20% of the exercise workload and with a 10-min recovery. The exercise workload is determined to entail a heart rate equivalent to a percentage of oxygen uptake (mostly starting at 50% to attain 80% at the end of the rehabilitation) prescribed by a cardiologist. The patients perform calisthenics exercises, relaxation, and rest in warm water five times a week to favor the social exchange between patients. Also, therapeutic education sessions are offered in groups of patients for 15–20 min per week. The proposed workshops discuss cardiovascular risk factors, signs and symptoms of the disease, lifestyle, control of stress related to daily management of the disease and exercise (i.e., intensity management, security, benefits).

### Statistical analysis

Statistical analysis is performed using SPSS (SPSS Inc., Chicago, IL). We perform descriptive statistics to describe our population. The quantitative variables are reported as mean  $\pm$  standard deviation (SD). A Student *t*-test is used to observe an effect of the rehabilitation program on the physiological and psychological parameters between time 1 and 2. We use an analysis of variance (ANOVA) to assess the effect of the rehabilitation program on depressive symptoms. A Pearson correlation coefficient test is realized to identify a possible relationship between physical deconditioning and the different depression scales. The differences are considered significant when *p* value is *p* < 0.05 with an alpha risk of 5%.

### Results

Our study is composed of 28 patients (22 men and six women) with a mean age of  $60.11 \pm 11.76$  years, a body mass index of  $26.80 \pm 5.54 \text{ kg m}^{-2}$ , a  $\dot{V}O_2$  peak of  $18.8 \pm 5.9 \text{ ml kg}^{-1} \text{ min}^{-1}$  and a physical fitness level of 63.3%. Within our population, there are 19 patients with a coronary artery disease (67.9%), seven patients with a valvulopathy (25%), one patient with an aneurysm rupture (3.6%) and one patient with hypertension (3.6%). We observe, depending on the severity of depression determined by scales (Table 1) in our population, that 50% (HADS) to 78.6% (BDI) of patients have no symptoms of depression and that 3.6% (BDI) to 14.3% (HADS) have symptoms of severe depression. Overall, we observe that 21.4–50% of patients have depressive symptoms, according to depression scales.

Table 1. Categorical analysis of the depression in our population by scales.

Scales	Categories	N	%	Depressive patients (%)
BDI	No depression	22	78.6	21.4
	Mild depression	5	17.9	
	Moderate depression	0	0.0	
	Severe depression	1	3.6	
GDS	No depression	21	75.0	25.0
	Mild depression	5	17.9	
	Severe depression	2	7.1	
CES-D	No depression	20	71.4	28.6
	Depression	8	28.6	
HADS	No depression	14	50.0	50.0
	Depressive disorders	10	35.7	
	Severe depression	4	14.3	

BDI: beck depression inventory; GDS: geriatric depression screening; CES-D: center for epidemiologic studies – depression; HADS: hospital anxiety and depression scale.

Table 2. Comparison of scores on depression scales by gender.

Variables	Time 1					Time 2								
	Men	Women	95% CI	<i>t</i>	DF	<i>p</i>	MD	Men	Women	95% CI	<i>t</i>	DF	<i>p</i>	MD
BDIa	9.00 $\pm$ 6.68 (1.42)	8.83 $\pm$ 4.96 (2.02)	(-6.21;5.88)	0.06	26	0.96	0.17	5.59 $\pm$ 4.38 (0.93)	12.00 $\pm$ 7.72 (3.15)	(1.49;11.32)	-2.68	26	0.01	-6.41
GDS	5.36 $\pm$ 5.98 (1.28)	10.00 $\pm$ 9.82 (4.01)	(-1.88;11.16)	-1.46	26	0.16	-4.64	3.64 $\pm$ 3.19 (0.68)	8.33 $\pm$ 6.83 (2.79)	(0.77;8.62)	-2.46	26	0.02	-4.70
CES-D	10.68 $\pm$ 7.41 (1.58)	14.67 $\pm$ 10.33 (4.22)	(-3.64;11.61)	-1.07	26	0.29	-3.98	7.36 $\pm$ 7.22 (1.54)	12.00 $\pm$ 7.64 (3.12)	(-2.27;11.55)	-1.38	26	0.18	-4.64
HADS	11.95 $\pm$ 5.88 (1.25)	13.50 $\pm$ 5.54 (2.26)	(-3.96;7.05)	-0.58	26	0.57	-1.55	8.50 $\pm$ 3.61 (0.77)	13.67 $\pm$ 7.34 (3.00)	(0.84;9.49)	-2.46	26	0.02	-5.17
Physical deconditioning	35.01 $\pm$ 20.49 (4.37)	32.16 $\pm$ 31.90 (14.27)	(-12.46;-1.83)	0.25	25	0.80	2.85	-	-	-	-	-	-	-
VO <sub>2</sub> peak	20.06 $\pm$ 5.21 (1.11)	12.91 $\pm$ 5.22 (2.33)	(-26.01;20.32)	2.77	25	0.01	7.15	22.69 $\pm$ 6.84 (1.46)	19.08 $\pm$ 10.01 (4.48)	(-11.20;3.98)	0.98	25	0.34	3.61

DF: degree freedom; MD: mean difference; BDI: beck depression inventory; GDS: geriatric depression screening; CES-D: center for epidemiologic studies – depression; HADS: hospital anxiety and depression scale; VO<sub>2</sub> peak: maximal oxygen consumption ( $\text{ml kg}^{-1} \text{ min}^{-1}$ ). Values are expressed as mean  $\pm$  standard deviation (standard error). <sup>a</sup>Does not mean effect of gender or time, but an interaction effect between men and women (*p* < 0.01).

**Table 3.** Statistical analyses between time 1 and time 2 on different variables studied.

Variables	Time 1	Time 2	95% CI	t	DF	p Value
BDI	8.96 ± 6.27 (1.18)	6.96 ± 5.76 (1.09)	(-0.19;4.19)	1.87	27	0.07
GDS	6.36 ± 7.03 (1.33)	4.64 ± 4.52 (0.85)	(-0.57;4.00)	1.53	27	0.14
CES-D	11.54 ± 8.08 (1.53)	8.36 ± 7.42 (1.40)	(-0.15;6.50)	1.96	27	0.06
HADS	12.29 ± 5.74 (1.08)	9.61 ± 4.98 (0.94)	(0.92;4.43)	3.13	27	0.004
MAP	85.97 ± 45.75 (8.80)	104.89 ± 53.63 (10.32)	(-33.79;-4.05)	-2.62	26	0.02
MHR	109.27 ± 24.45 (4.71)	118.56 ± 32.51 (6.26)	(-23.38;4.80)	-1.35	26	0.19
$\dot{V}O_2$ peak	18.74 ± 5.84 (1.12)	22.02 ± 7.43 (1.43)	(-5.84;-0.73)	-2.65	26	0.01

DF: degree freedom; BDI: beck depression inventory; GDS: geriatric depression screening; CES-D: center for epidemiologic studies – depression; HADS: hospital anxiety and depression scale; MAP: maximal aerobic power; MHR: maximal heart rate;  $\dot{V}O_2$  peak: maximal oxygen consumption ( $ml\ kg^{-1}\ min^{-1}$ ).

Values are expressed as mean ± standard deviation (standard error).

**Table 4.** Pearson's correlation coefficient test between the physical deconditioning and the different depression scales.

Variable	BDI		GDS		CES-D		HADS	
	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
Physical deconditioning	-0.05	0.09	-0.08	-0.12	0.11	-0.02	-0.13	-0.24

BDI: beck depression inventory; GDS: geriatric depression screening; CES-D: center for epidemiologic studies – depression; HADS: hospital anxiety and depression scale.

**Table 5.** Repeated measures ANOVA's analyses according to improving maximum oxygen consumption ( $\dot{V}O_2$  peak) and physical deconditioning level of patients.

Scales	Test	Condition	DF	MS	F	p Value
<i>According to improving maximum oxygen consumption (<math>\dot{V}O_2</math> peak)</i>						
BDI	Intra-patients	Time	1	80.42	5.60	
	Inter-patients	Time × $\dot{V}O_2$ peak improvement	1	11.97	0.83	0.37
GDS	Intra-patients	Time	1	45.81	2.49	0.13
	Inter-patients	$\dot{V}O_2$ peak improvement	1	66.92	1.42	0.24
CES-D	Intra-patients	Time	1	184.62	5.16	0.03
	Inter-patients	Time × $\dot{V}O_2$ peak improvement	1	11.28	0.32	0.58
HADS	Intra-patients	Time	1	112.18	10.78	<0.001
	Inter-patients	$\dot{V}O_2$ peak improvement	1	19.08	0.24	0.63
	Intra-patients	Time × $\dot{V}O_2$ peak improvement	1	0.18	0.02	0.90
	Inter-patients	$\dot{V}O_2$ peak improvement	1	99.73	2.34	0.14
<i>According to physical deconditioning level</i>						
BDI	Intra-patients	Time	1	76.48	5.24	0.03
	Inter-patients	Time × physical deconditioning	1	6.41	0.44	0.51
GDS	Intra-patients	Time	1	45.00	2.41	0.13
	Inter-patients	Physical deconditioning	1	2.64	0.05	0.82
CES-D	Intra-patients	Time	1	182.43	5.04	0.03
	Inter-patients	Time × physical deconditioning	1	1.39	0.04	0.85
HADS	Intra-patients	Time	1	115.19	11.57	<0.005
	Inter-patients	Physical deconditioning	1	29.78	0.38	0.54
	Intra-patients	Time × physical deconditioning	1	11.49	1.15	0.29
	Inter-patients	Physical deconditioning	1	17.44	0.38	0.54

DF: degree freedom; MS: mean square; BDI: beck depression inventory; GDS: geriatric depression screening; CES-D: center for epidemiologic studies – depression; HADS: hospital anxiety and depression scale.

A significant difference has been shown by gender on the scores of BDI, GDS, and HADS (Table 2). The women have depression scores significantly higher than the men on these three scales at time 2; only CES-D do not show a significant difference. Moreover, depression scores in men seem to decrease at time 2, comparatively to time 1. Also, at time 1, men have a  $\dot{V}O_2$  peak that is significantly higher than women.

The rehabilitation program improves the  $\dot{V}O_2$  peak and the MAP (Table 3). HADS have a significant decrease in the depression scores at the end of the rehabilitation program, whereas CES-D and the BDI present a tendency to decrease. No significant improvement of the heart rate at the end of the rehabilitation program is shown.

The results show no correlation between physical deconditioning and the different scores of the depression scales (Table 4).

The patients are separated into two groups according to the median to observe the effect of improving the  $\dot{V}O_2$  peak on their depression scores. The group 1 has the lowest improvement of  $\dot{V}O_2$  peak. The effect of the rehabilitation program according to the improvement of  $\dot{V}O_2$  peak and to each depression scale is visible in Table 5. The repeated measures ANOVA's analyses show an effect of time on intra-patients for the BDI, CES-D, and HADS; no inter-group effect and no interaction effect are observed. The effect of the rehabilitation program according to physical deconditioning and to each depression scale is visible in Table 5. The repeated measures ANOVA's analyses show an effect of time on

intra-patients for the BDI, CES-D, and HADS; no inter-group effect and no interaction effect are observed.

## Discussion

The aim of this research is to study the physiological and psychological dimensions in patients during a cardiac rehabilitation program. Overall, we observe that patients have improved their depressive symptoms and their physical fitness at their exit of the rehabilitation program, comparatively to their entry.

It is particularly important to target different depression scales in a same studied population because, even if they are standardized tools, there is not a scale that is favored in comparison to another for older adults [23]. Also, the patients with CVDs have relatively high scores of depression, which seems to differ from one scale to another [22]. According to the categorical approach and the scales used, we observe that between 21.4% and 50% of the patients evaluated have depressive symptoms; this observation is in accordance with the literature [22,23]. For example, it is observed in chronic heart failure that the prevalence of depression is high (10–60% depression) [22]. The sensitivity of these scales in our population may be due to the fact that some are generic while others are specific. Indeed, patients with a cardiac disease have a rate of depression twofold higher than the general population [9,32]. However, according to the scales used, we identify different depression scores from one scale to another. Our results show that between 3.6% and 14.3% of patients received a diagnosis of severe depression. These results are important because all scales which examine the prevalence of depression are self-report measures. A patient with a score inferior to 9/63 by the GDS is considered to have no depression. If a patient has a score superior to 10/63, he would then be considered to have a depression ranging from mild to severe. The categorical approach allows the classification of patients by the presence or absence of a trait. Moreover, a patient may be categorized as having symptoms of depression by the GDS, whereas the categorization by the BDI is reversed. This illustrates that the sensitivity of the depression scales is not yet perfect and deserves to be studied. We note that with the BDI, one on five patients is categorized as being depressive, whereas for the HADS, the depression concerns one of two patients. For the HADS, we observe no consensus on the values of the thresholds used to classify patients. The cutoff for establishing the sensitivity and specificity values is different, according to studies [33,34]. According to the optimal cutoff to screen depression in patients with CVDs, the score in the HADS  $\geq 8$  [33], whereas, according to Bjelland et al., the cutoff range is from 4 to 11 [34]. A cutoff too low has for effect an increase in the number of false positives and inversely [35]. Some depression scales overestimate the depression symptoms while other underestimate these symptoms. Our results suggest that the prevalences for the HADS are different from the other three depression scales, which are similar to one another. Our findings show that men have depression scores significantly lower than women after a rehabilitation program (time 2) for the BDI and GDS. This is consistent with previous work, which shows that women have significantly higher depression scores on the BDI [36]. This can be explained by the fact that men give more importance to goal-oriented factors (i.e., improvement of  $\dot{V}O_2$  peak), whereas women give more importance to interpersonal relationships while internalizing symptoms [37,38].

Regardless of the gender, the rehabilitation program has an effect on the depression score of patients at their exit. Our results show that the practice of physical activity improves the

physiological parameters (i.e., MAP and  $\dot{V}O_2$  peak) and decreasing the depression scores in patients with CVDs. The improvement in physical fitness level (i.e.,  $\dot{V}O_2$  peak) is shown to be correlated with improvements of the depression factors [39]. This reduces the deleterious effects associated with the disease because patients with depression and CVDs observe a quicker loss of physical function [8] resulting in the appearance of a physical disability [40]. Indeed, the CVDs patients who have a low functional autonomy have a greater severity of their symptoms and a weaker health-related quality of life, comparatively with CVDs patients without depression [41,42]. Nevertheless, contrary to what the literature observes [39], the physical deconditioning level does not influence the depression score between time 1 and time 2. Indeed, our results show an effect of the rehabilitation program on the depression score, independently of the patient's physical deconditioning level and of the improvement of the  $\dot{V}O_2$  peak. Patients who have improved their  $\dot{V}O_2$  peak the most do not show a significant decrease in their depression scores, compared to patients who have not improved their  $\dot{V}O_2$  peak. The absence of a control group forces us to remain careful with our results. However, these results may be explained by the social component of our study, which is also the strength of our rehabilitation program. Where most studies put the spotlight on cardiorespiratory response at the expense of psychological responses, our study brings an innovative aspect to current cardiac rehabilitation programs. Indeed, in this study, there is social exchange since the majority of exercise sessions are conducted in a group several times a day. Patients have time to talk and exchange between the activities. The gymnastics activities are an essential component of this rehabilitation program because they consist of short exercise sessions with recovery phases enabling patients to interact with each other more easily. The inclusion of psychological components in cardiac rehabilitation programs should be standard practice by adapted physical activity professionals to improve patient care.

Compared to other studies, which usually take place between 4 and 12 months [43–45], the duration of our program is shorter. Indeed, the duration of the exercise training program is twofold less than other studies [43] and the impact of rehabilitation on improving  $\dot{V}O_2$  peak and depressive symptoms could be underestimated compared to longer rehabilitation programs. Nevertheless, this does not prevent an improvement in  $\dot{V}O_2$  peak of 17.5% in our study. Despite a relatively short rehabilitation program, it is extremely encouraging to observe such effects. Our results are similar to previous studies [44,46] and are higher than others [47]. In the literature, a cardiac rehabilitation program reduces from 20% to 32% probability of all-cause mortality [43]. Although these effects are known, many patients often stop the program after a few months of rehabilitation due to external constraints; it is essential to help them become autonomous. The depressive symptoms worsen these aspects, which does not lead to a healthy lifestyle [48]. These results are encouraging in the actual context of patient care which promotes, mostly, the improvement of physiological capacities over the psychological aspects.

## Limitations

Our study identifies some limitations. The first one concerns our number of patients ( $n = 28$ ) which is low compared to other studies in the same field. Moreover, our population is unbalanced regarding the number of men and women, but this did not prevent us from observing interesting differences between them. The

second one is that we observe in this study a high prevalence between depression scores. Thus, we invite the reader to be more careful in using these depression scales. A diagnosis of depression should not be identified only with one depression scale. In order to have a better diagnosis, it is necessary to couple the depression scales with clinical interviews. Also, it might have been interesting to study the PHQ-9 questionnaire to complete our results. This study being retrospective (data collected in May 2008), we did not know the American Heart Association recommends concerning the PHQ-9 [49]. Finally, patients could have different physical fitness level related to environment (i.e., physical activity), which might vary the response of each patient in the rehabilitation program.

## Conclusions

This study shows the importance of measuring depression and its severity to improve the care of patients. However, our findings show that between 21.4% and 50% of the patients have depressive symptoms and that 3.6–14.3% of patients received a diagnosis of severe depression. The categorical approach which allows classifying patients is questioned. Finally, an effect of the rehabilitation program on both the physiological and psychological parameters is observed but readers should be careful with our results, promote a multidimensional approach and confirm the diagnosis by a psychologist. Following this study, the clinic has a psychologist in their team allowing the establishment of a psychological and physiological follow-up.

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## Disclosure statement

The authors take responsibility for all aspects of the reliability and freedom from bias of the data presented and their interpretation discussed. The authors report no declarations of interest.

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