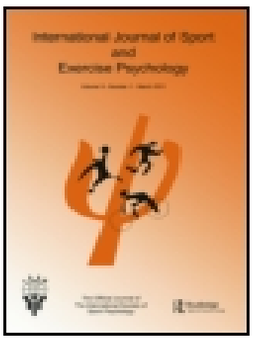

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NOTE

Work-based physical exercise benefits on NCCDs Chilean employees' mood and emotions: a preliminary study

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ABSTRACT

A protective work environment should account both for employees' health and for reducing psychosocial risk. Physical exercise during the workday could be a tool to improve working performance and reduce sickness-related absenteeism and work-related stress, especially for workers suffering from Non-Communicable Chronic Diseases (NCCDs). Our aim was to evaluate the short-term effects of physical exercise performed during the workday on employees' emotions (Anxiety, Dejection, Anger, Excitement and Happiness) suffering from NCCDs in Chile. A pre- and post- exercise emotions questionnaire was administered during each training session in the frame of a larger internal Institutional project aimed to reduce NCCDs symptoms in local University employees. This preliminary study ($N = 20$) was aimed to collect evidence of the short-term psychological benefits of such a program. Results show significant differences in the Anxiety, Excitement and Happiness levels as reported by the subjects before and after performing the physical routine each day of training. After the exercise, volunteers themselves acknowledged that they felt "better and relieved" (i.e., less anxious, more excited and happier) at the end of the 30-minute training. This preliminary study shows that even a short physical exercise program could be an effective tool to increase employees' positive mood and reduce anxiety. This suggests that exercise could be a key factor for institutions to develop guidelines for reducing psychosocial occupational risk and disease prevention in the workplace. Further investigation with larger sample sizes and different populations is needed to generalize these outcomes and evaluate long-term benefits according to individual differences and health issues.

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Exercise psychology; health promotion; psychosocial factors

Introduction

Health not only refers to the absence of disease but also to a state of complete physical, mental and social well-being (World Health Organization [WHO], 2017a). It has been

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extensively reported that work-related stress and a bad working environment may represent a costly social phenomenon (Hassard et al., 2018) and a psychosocial risk (Milczarek, 1831), which translate into considerable monetary losses. Additionally, many jobs imply sitting for long spans of time in a chair, obliging employees to assume bad postures for several hours, and this could lead to moderate to severe pain or physical distress (Esquirol et al., 2017), especially if the worker already suffers from a diagnosed health condition. Non-communicable chronic diseases (NCCDs), for example, are diseases of long duration, generally slow progression and are the result of a combination of genetic, physiological, environmental and behavioural factors (WHO, 2017b). Specifically, the high metabolic risk to NCCDs correspond to a category of diseases ranging from obesity to dyslipidaemia or diabetes, which showed an increase rate of mortality within the last decades and are often associated with a sedentary lifestyle and work. The WHO estimates, each year, that approximately 15 million people die from a NCCD between the ages of 30 and 69 years old; over 85% of these "premature" deaths occur in low- and middle-income countries (Hassard et al., 2018; WHO, 2019). In Chile, the annual mortality rate per 100,000 people from non-communicable diseases has increased by 17.4% since 1990, an average of 0.8% a year, and it is nowadays the fourth Country in Latin America for NCCDs mortality rate (Global Disease Burden [GDB], 2017). It has been estimated that, worldwide, 1.6 million deaths every year can be attributed to insufficient physical activity (Forouzanfar et al., 2015). This drop in general health conditions has a direct consequence not only in the private sphere, but also in the workplace, for example when NCCD workers need to stay at home frequently due to chronic sickness. Along with this, and just to mention one problem, the economic cost in health benefits is about 15% more for obese individuals than those with normal weight. This percentage even increases when it comes to medical absences (Tello, 2015).

In developed countries, it has been acknowledged that Sickness Absence (SA) in the workplace is a growing problem, considering both the workers' health implications and economic losses; additionally, SA has a huge impact on well-being, self-esteem and on the livelihood of workers (Coggon et al., 2013). Musculoskeletal disorders (MSK) and mental health (MH) problems such as depression and anxiety account for the majority of days lost due to work-related illness (Health and Safety Executive [HSE], 2015). In Latin America, and in particular in Chile, there is a lack of evidence and concern about occupational health issues in general (Diaz-Ledezma et al., 2009), and there is generally a poor knowledge of the consequences that a lack of physical activity and bad workplace conditions might have on the employees both from medical and economical perspectives.

Benefits of regular exercise and physical activity on mental health have been discussed in international literature and are currently almost taken for granted (Barnes, 2006; Biddle et al., 2000; Biddle & Asare, 2011; Isoard-Gautheur et al., 2019; Salmon, 2001; Singer, 1992). Exercise has been shown to reduce stress (Taylor, 2000), which is one of the main reasons for job burnout (Isoard-Gautheur et al., 2019), and also anxiety (Aşçi, 2003; Dunn et al., 2003), or even depression (Craft & Landers, 2016; Dimeo et al., 2001; Fox, 1999; O'Neal et al., 2000). On the other hand, physical activity and exercise have benefits in promoting a general psychological well-being and positive emotions such as happiness (Hills & Argyle, 1998), and their effects are related to positive mental health indices such as well-being and self-concept (Fox, 1999, 2000; McDonald & Hodgdon, 2012). Amongst

other leisure activities, physical exercise is one of the strongest ways to improve positive feelings such as happiness and reduce negative emotions on a short-term basis (Hills & Argyle, 1998). In some cases, aerobic physical activity has been shown to produce acute improvement of depressive and anxiety symptoms even after a single exercise episode, lasting for some hours or even up to one day (Koltyn et al., 1995; Landers et al., 2007; Taylor, 2000). This is thought to be due to an association between hormonal system changes happening during exercise and positive affects and emotions. For example, lower cortisol output are registered among individuals reporting positive effects, which moreover shows favorable associations with heart rate, blood pressure, and inflammatory markers such as interleukin-6 (Steptoe et al., 2009).

Occupational well-being can be modelled in a multidimensional way (considering and including affective, cognitive, professional, social and psychosomatic dimensions, broader conceptualizations of well-being, such as motivation, competence, efficacy, etc.; Van Horn et al., 2004), where it has been shown that the affective dimension (e.g., job satisfaction, commitment, depression, etc.) is the most central one, supporting earlier views of the construct (Diener et al., 1999). Therefore, it is of great importance to give enough space to the emotional and affective dimension when promoting occupational health care and well-being, because of its close connection with good medical conditions and a healthy lifestyle.

The relationship between exercise and occupational health has been already pointed out in some studies (Koren et al., 2016; von Thiele Schwarz & Hasson, 2011; Von Thiele Schwarz & Lindfors, 2015), showing that exercise programs during regular work hours improve not only workers' productivity, but also diminishes absenteeism because of medical conditions, largely reducing monetary losses. In the matter of facts, there are few reported implementation of early interventions to reduce SA in employees with respect to interventional care programs to minimize the health and occupational impact of such a phenomena, that are usually implemented after the employee already got sick (Vargas-Prada et al., 2016). Promoting employees' well-being and health directly in their own workplace by means of physical activity might be a better strategy to reduce SA, improve their health and mood and reduce occupational costs at the same time. In particular, High Intensity Interval Training (HIIT) exercises have been shown to improve cardiovascular fitness and muscular resistance (Abarzúa et al., 2019) and has similar or higher effects with respect to Continuous exercises of Moderate Intensity (Nugent et al., 2018). In fact, HIIT offers metabolic, muscular and cardiac improvements, as well as increases in ventilation and anaerobic capacity (due to the recruitment and activation of motor units), in addition to more oxygen consumption, which in turn promotes mitochondrial and enzyme activity, cardiac contractility, and ejection (Bermejo et al., 2018), and has been shown to improve insulin sensibility (Fisher et al., 2015). This kind of training has been proven to help reducing cardio-metabolic risk factors (Fisher et al., 2015) and fat mass due to increased catecholamines and lipolysis (Bermejo et al., 2018), which are key problems with most NCCDs. Some of the most frequently reported HIIT exercises in literature are the cycle ergometer (Bermejo et al., 2018; Fisher et al., 2015), or strength exercises with weights, which produce metabolic and cardiorespiratory improvements, and even exercises with body weight (jumps, burpees, agility, etc.; Bermejo et al., 2018).

These kind of exercises have of course benefits for any person, but they could be especially effective for NCCD suffering individuals, as their physical fitness and

coordination functions are diminished, putting them in worse overall morphofunctional conditions. The above mentioned sedentary component due to working conditions, for example, or the absence of physical activity, are some of the causes reported in the generation of obesity (Tello, 2015), which in turn is associated with various NCCDs and increased mortality (Villarroel et al., 2013). This situation puts the NCCD-suffering workers in a scenario of greater reluctance to perform physical exercise, so that, the effects at the "adherence to physical exercise" level could be more relevant with respect to non-NCCD-suffering people, bringing important changes in the self-improvement and self-worth aspects. This change, we believe, also passes to their emotional state, as the acknowledgement that physical activity has a boosting effect on their overall mood (at least in the short-term, improving the rest of the workday, especially when they were facing stressful job-related situations) might overcome their reluctance to perform some exercises, which are beneficial to their physical health conditions as well.

In the present preliminary study, volunteers were internal workers employed in different departments of UCM and corresponded to people who suffered from one or more of the following medical diseases (NCCDs): hypertension, diabetes, dyslipidemia, overweight and obesity. The main aim of the*"Physical exercise for adults with non-communicable chronic diseases"* project from the Human Performance Lab of the Catholic University of Maule (Universidad Católica del Maule, UCM) was to determine the efficacy of an aerobic High-Intensity Interval Training (HIIT), followed by moderate intensity and muscular strength training on controlling NCCDs symptoms comparing metabolic variables, aerobic capacity and muscular strength before and after the intervention.

In the frame of this larger project (whose results have been described in Faundez-Casanova et al., 2019), the purpose of the present preliminary study was to quantify, on a short-term basis, the differences in the emotional state before and after the physical exercise sessions to be performed during employees' workday. The specific objective was to test the hypothesis that a simple 30-minutes exercise routine could significatively enhance short-term workers' positive emotions and diminish negative ones.

Besides, the outcomes of the present preliminary study will allow us to evaluate the convenience of developing a wider project with a greater sample and improved battery of measurements-tests and questionnaires.

Materials and methods

The study had an experimental design with a within-subjects pre- and post-treatment structure, where the treatment in this case is the physical exercise routine, and the pre-/post- answers were given each time the subjects performed the training (many times per week). This means, that we had many observations of the same subject (Total observations: 588; Mean of observations per subject: 32.7; Median value: 42 observations; Standard Deviation: 14.5), registered each day of he/she attended the physical training, allowing us to calculate a stable indicator of each subject's effect of physical activity on their mood and emotions. The pre-exercise answers can be considered their own daily "Baseline" condition, since participants completed the first session of the SEQ as soon as they entered the lab each day. The great number of observations per subject (total of observations: 588) somehow overcomes the limitations due to the low

number of participants in our project. It is important to stress the fact that the investigated population was a limited sample of those UCM non-academic employees (from a total of less than 500 employees of this regional University) who suffered from any NCCD and who kept on coming to the lab to perform the routine. Since the participation to the project was free, no one had the obligation to continue. In fact, we suffered from a small participation decrease, as we will detail in the next paragraph.

Participants

This study included volunteers following the screening procedure of the aforementioned *Physical exercise for adults with non-communicable chronic diseases* UCM project. The research protocol followed the Declaration of Helsinki standards (2013), which are declared in the guidelines of the Ethics Committee of the Catholic University of Maule, Chile (CEC UCM; IRB approval code: N° 102 / 2019). The initial sample was of 20 participants, but finally, due to dropout from the project or incompatibility with work-schedule, only 18 continued until the end of the program. The final sample was composed of 18 volunteers (16 women, 2 men), with an average age of 43.24 years old (SD = 7.1), suffering from the following NCCDs: (a) diabetes ($n = 2$), (b) dyslipidemia ($n = 5$), (c) obesity ($n = 11$) as a main health condition. Participants underwent the screening criteria for NCCDs described in the following paragraph.

Screening for NCCD and instruments

Before starting the training sessions, all volunteers passed through a preliminary screening session where biometric information was registered, in order to get demographic data about our sample and proceed with a distribution of volunteers according to their reported NCCD. First criteria was that participants had a medical diagnosis of one NCCD. In order to determine each health condition, participants completed a self-report indicating the perceived or diagnosed risk condition. Those who did not have a medical diagnosis were evaluated according to vital signs and ambulatory hematologic analysis, and their results compared with parameters, which have been recognized as risky for each of the considered pathologies. Criteria to include participants in this study (risk cut point) respond to recommendations from different international health agencies, such as WHO, AHA, and others, considering the parameters presented in Table 1.

Table 1. Criteria to include participants with NCCD in this study (risk cut point) respond to recommendations from different international health agencies, such as WHO, AHA, and others, considering the following parameters.

Condition	Normal cut point	Risk cut point	References
Blood pressure	<Systolic 120 mmHg <Diastolic 80 mmHg	>Systolic 130 mmHg >Diastolic 85 mmHg	AHA (Arnett et al., 2019)
Heart rate	60–100 bpm	<40–>120 bpm	NHS, UK (2018)
BMI	<18.5–>25 kg/m^2	>30 kg/m^2	OMS
Total Cholesterol	<200 mg/dL	>240 mg/dL	NIH, US (2005)
Tryglicerids	<150 mg/dL	>150 mg/dL	NIH, US (2005)
Glycemic	70–100 mg/dL	>125 mg/dL	MINSAL (2008)

Systolic Blood Pressure (SBP), Dyastolic Blood Pressure (DBP) and Heart Rate (HR) at rest have been determined with an automatic blood pressure monitor model BP760 serie 7 (OMRON, Japan). Body mass and height have been measured with a mechanical scale with stadiometer model 3P7044 140 kg capacity (DEFECTO, USA), and the BMI and fat percentage with a fat loss monitor model HBF-306C (OMRON, Japan), tryglicerids and total cholesterol with the Accutrend Pluss Cobas (Roche, Germany) and glycemy with Accu-Chek Performa Nano (Roche, Germany).

Questionnaire administration and experimental procedure

The Sports Emotions Questionnaire (SEQ; for statistical facts, internal and external validity of the instrument, see Jones et al., 2005; there is currently no Spanish validated version for this questionnaire; for reliability information of our Spanish-translated version, see further in this section, paragraph "Statistical analysis") was used to evaluate the pre- and post-exercise emotional state of each participant. It is a 22 item questionnaire designed to assess five basic emotions divided as follows: Anxiety (5 items); Dejection (5 items); Anger (4 items); Excitement (4 items); Happiness (4 items). Participants had to respond how they felt in that precise moment on a scale from 0 (Not at all) to 4 (Extremely).

Its primary sport-specific use is to measure pre-competitive emotions, but it has also been successfully employed to evaluate recalled emotions in a sport setting (Vast et al., 2010). Instead, we are evaluating its use in a physical activity-related situation, where physical exercise is supposed to promote a change in the subjective perception of emotions and feelings as answers to the SEQ were collected before and after the exercise each time the participants had a training session.

Participants to this preliminary study were undergoing a series of physical exercises during the frame of the second stage of the aforementioned internal project. They were asked to answer the SEQ questionnaire twice: (1) right before and (2) some minutes after the physical activity for the total duration of the program (see Figure 1 for the experimental procedure). The instruction was to answer each item considering how he/she felt *in that precise moment*, thinking in their overall actual mood (not related to their feelings about exercise or the experimental setting). This procedure was applied to each subject each time he/she came to the lab to perform his/her routine for the total duration of the project.

Final evaluation questionnaire

One week after the end of training project, an open questionnaire has been administered to each participant to inquire the volunteers on the following: (a) if they liked participating in the program; (b) if they like sports in general; (c) if they think that exercise improved not only their physical, but also their psychological and emotional states; (d) if they think that their answers to the questionnaire before performing the exercise were different from the ones delivered after the physical activity to the same questionnaire; (e) if the answer was yes, to write down the reasons for those differences and how the answers differed when comparing the two questionnaires; (f) if they planned to keep doing some kind of exercise in the future, considering the actual psychophysical benefits of physical activity.

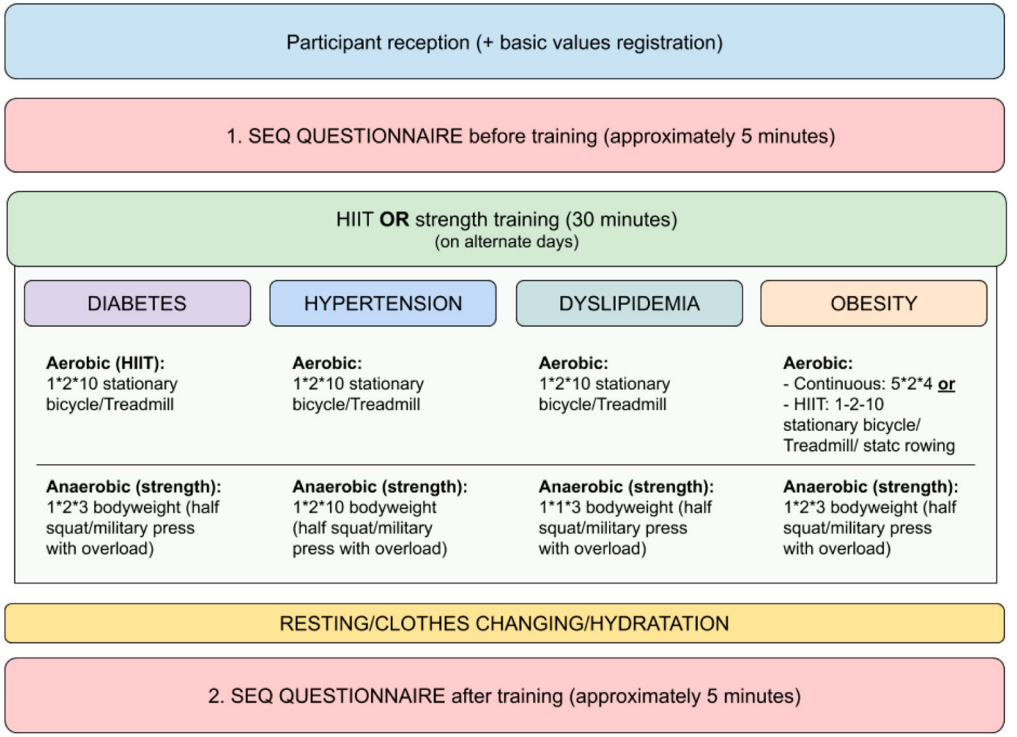

Figure 1. A diagram representing the experimental procedure for each exercise-session-day. Each subject repeated this procedure 2 or 3 times per week for aproximately 6 weeks.

Physical exercise training schedule

Participants underwent a 10 -week exercise program in the first stage; then, after a break of 5 weeks, a second stage of 17 weeks started. The supervising team was composed by a Physical Education teacher and two students in their the last year of the "Health and Physical Activity" career at the University.

The aim of the main project was to determine the efficacy of an aerobic High-Intensity Interval Training (HIIT), followed by moderate intensity and muscular strength training on controlling NCCDs symptoms comparing metabolic variables, aerobic capacity and muscular strength before and after the intervention, (results of this project are described in Faundez-Casanova et al., 2019). Within the frame of the above mentioned project and compatibly with their regular working schedule, participants performed various times per week (2–3 times per week): (a) an aerobic resistance exercise of moderate and high intensity on a stationary bicycle, being the moderate intensity with an average percentage (50–70%) of the theoretical maximum Heart Rate adjusted by age (220-age) and the high-intensity routine close to the maximum threshold (80–100%) of theoretical maximum Heart Rate adjusted by age (aHR); and (b) an anaerobic strength resistance exercise, with two exercises for arms and two for legs, with intensity appropriated to the subjective perception of the effort (moderate to high). Subjective intensity was calculated according to the Borg Perceived Exertion Rate from 6 to 20 (Borg & Kaijser, 2006). For the muscular strength, intensity was measured with the RPE from 0 to 10 with a range from 4 to 8 as the weeks passed, and with 4 exercises (2 arms exercises and 2 legs exercises, usually medium squat and military press with overload). Each participant received a HR monitor model V800 (Polar Electro, Finland) registering each session during the entire program. Session protocols were different according to the medical conditions of each subject (see Table 2).

Statistical analyses

Since there is no "official" Spanish version of the SEQ Questionnaire (Jones et al., 2005), we translated the items ourselves with the "back-translation" method. Therefore, in order to have measures of the effectiveness of our version, we performed a reliability test on all the collected 588 observations, finding that, in our sample, the 5 factors have high reliability: Anger (Cronbach's $\alpha = 0.94$), Anxiety (Cronbach's $\alpha = 0.89$), Dejection (Cronbach's $\alpha =$

Table 2. HIIT sessions protocols according to subject's medical conditions.

	Aerobic HIIT		Strength HIIT	
Medical condition	Training[a]	Max aHR	Training[a]	Load
Diabetes[b]	1*2*10	80%	1*2*3	Overload
Hypertension	1*2*10	50–70% (adaptation) 80–100% (development)	1*2*10	Medical ball (2–3 kg)
Dyslipidaemia[c]	1*2*10	80–100%	1*1*3	Overload
Obesity[d]	Continuous: 5*2*4	70% (adaptation) 80% (development)	1*2*3	Overload
	HIIT: 1*2*10	80–85% (adaptation) 80–100% (development)		

[a]Training: Exercise time * recuperation time * repetitions.
[b]Mancilla et al. (2014).
[c]Álvarez et al. (2014).
[d]Álvarez et al. (2012).

0.93), Excitement (Cronbach's $\alpha = 0.93$) and Happiness (Cronbach's $\alpha = 0.93$). We report these values together with the SEQ author's ones in Table 3 (Jones et al., 2005) for a direct comparison.

As our dependent variable constituted a within-subjects repeated measure, preliminary normality check was performed on the distribution of the difference between Session 2 – Session 1 values representing the average scores for each Emotion; we observed that they had a normal distribution (calculated with Shapiro Wilk's formula for small sample sizes), except "Dejection" ($W = 0.826$; $p < .05$) and "Anger" ($W = 0.799$; $p < .0\,05$). Therefore, the dependent variable was the mean of the scores for 3 out of the 5 SEQ scale Factors (from now on, "Emotions"; for more information on statistical facts about this instrument, see Jones et al., 2005) for each subject and the medians of the other 2 Emotions which resulted to have a non-normal distribution. This way, for Anxiety, Excitement and Happiness we used the subject's mean value for the Session 1 (or Baseline, collected before starting the exercise) and the mean value for the Session 2 (after the exercise), while for Dejection and Anger we used the medians for both Sessions 1 and 2.

For this reason, and because of the small sample ($N = 18$), we performed on a first instance a non-parametric significance test (the Wilcoxon signed-rank test for independent samples) on each pair of Emotions to be sure of the significance of our results. After that, and after consulting a statistical expert, we decided to also run a parametric test (*T*-Test), again using the median of Dejection and Anger values instead of means (because non-normality of their means' distribution). This allowed us to get some important statistical indicators (such as the correlation values between Pre- and Post-exercise means of each emotion) giving us the proof that our preliminary results are robust enough to be discussed.

The *T*-Test analysis was performed as a dependent sample paired analysis on each pair of emotion's scores (pre- and post-exercise) to confirm previous non-parametric analysis; we also run a correlation for each pair of scores for each Emotion (mean values for Anxiety, Excitement and Happiness and median values for Dejection and Anger) to have a direct measure of the fact that the pre- and post-exercise scores of each subject were actually correlated (calculated with Pearson's R), indicating that the difference between the scores is due to the exercise and not to some other confounding subject-related variable.

Table 3. Demographic information of our sample.

	Total ($n = 18$)		Female ($n = 16$)		Male ($n = 2$)	
Variables	Mean	SD	Mean	SD	Mean	SD
Age (years)	43.24	7.1	43.36	7.46	42.35	4.74
Weight (kg)	85.69	19.98	82.48	16.36	111.35	1.91
Height (cm)	158.33	9.9	155.56	5.99	180.5	4.95
BMI (kg m^{-2})	34.02	5.47	33.99	5.79	34.23	2.46
Fat (%)	41.42	5.13	42.51	4.21	32.7	3.11
Heart Rate (HR)	77.17	10.34	77.69	10.67	73	8.49
SBP resting (mmHg)	123.33	18.57	121.5	18.64	138	12.73
DBP resting (mmHg)	86.17	11.26	85	11.43	95.5	0.71
Cholesterol (mg/dl)	214.38	33.87	215.5	35.1	210	31.11
Triglycerides (mg/dl)	220.39	97.96	214.38	101.74	268.5	51.62
Glycaemia (mg/dl)	100.83	23.07	101.38	24.49	96.5	3.53

Notes: SBP: systolic blood pressure; DBP: dyastolic blood pressure.

As a complementary measure to the SEQ Questionnaire, we collected additional answers about the subjective perception related to the experience and the effects of the exercise on participants' emotions one week after the last session. The final qualitative measures have been analyzed with descriptive statistics.

All the statistical analyses have been carried out with the statistical software SPSS (SPSS Inc, 2009).

Results

Demographic data

Our sample had the demographic information distributed as shown in Table 3. Results of the main project involving these collected data can be found in Faundez-Casanova et al., 2019.

Quantitative data

Due to the low number of participants in our sample ($N = 20$) and since the "Dejection" and "Anger" pre-/post- difference scores did not reflect a normal distribution as described in the previous paragraph, a non-parametric comparison was firstly performed to check the significance of the explored effects. We used the Wilcoxon signed-rank test for independent samples on each pair of Emotions. Three out of the 5 emotions (Anxiety, Excitement and Happiness) showed significant *p*-values, while Dejection and Anger did not (Anxiety, $Z = -3.68$, $p < .001$; Dejection, $Z = -1.84$, $p = .066$; Anger, $Z = -1.693$, $p = .090$; Excitement, $Z = 3.724$, $p < .001$, Happiness, $Z = 3.724$, $p < .001$), indicating that the SEQ scores reflecting the Emotions of Anxiety, Excitement and Happiness felt by the subjects are significantly different before and after the exercise session. Observing the estimated means of each emotions' mean scores, a clear pattern of lower negative emotion ratings after the exercise (Session 2) with respect to the Session 1 can be observed: Anxiety before ($M = 1.173$; SD = 0.652) and after ($M = 0.833$; SD = 0.567); Dejection before ($M = 0.940$; SD = 0.602) and after ($M = 0.719$; SD = 0.508); Anger before ($M = 0.935$; SD = 0.613) and after ($M = 0.692$; SD = 0.498). On the other hand, positive feelings show the opposite pattern, with higher scores in the "After" training (Session 2) compared to Session 1: Excitement before ($M = 1.985$; SD = 1.057) and after ($M = 2.485$; SD = 0.981); Happiness before ($M = 2.053$; SD = 0.965) and after ($M = 2.511$; SD = 0.925). Therefore, a lower intensity of negative emotions can be observed after the training with respect to immediately before starting to exercise. On the other hand, positive emotions (i.e., Excitement and Happiness) are present at the end of the physical activity (Figure 2) with higher mean scores.

To add more evidence to these data, dependent sample paired *T*-Tests analysis on each pair of emotion's scores (Session 1, Session 2) have been run resulting all significant (Anxiety: $t = 4.137$, $p = 0.001$; Dejection: $t = 2.421$, $p < 0.05$; Anger: $t = 2635$, $p < 0.05$; Excitement: $t = -6.113$, $p < 0.001$; Happiness: $t = -5.672$, $p < 0.001$). In Table 1 we summarized the *T*-Test results. If we focus on the Pearson's correlations between the Session 1 and 2 means obtained performing the *T*-Test analysis, we can see that all the Pre-/Post-exercise mean values for each Emotion were highly correlated (Anger: $r = 0.547$; Anxiety: $r = 0.845$; $p < 0.001$; Dejection: $r = 0.692$; $p = 0.001$; $p < 0.05$; Excitement: $r = 0.945$; $p < 0.001$;

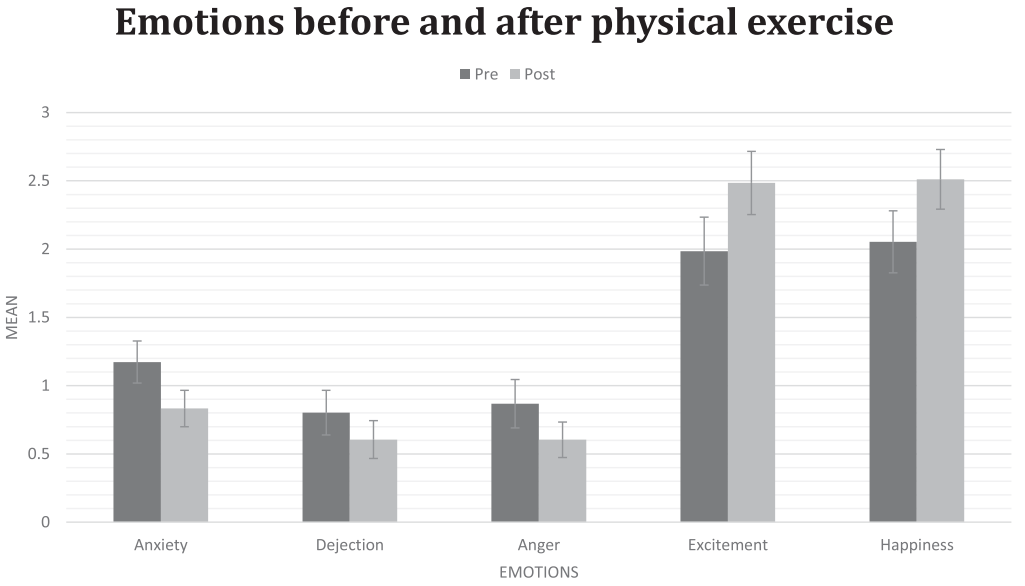

Figure 2. Effects of physical exercise on emotions from the SEQ Questionnaire scores before ("Pre", dark bars) and after ("Post", bright bars) training. In the X axis, the mean of the sums of the item satisfying each of the 5 factors (Emotions) is represented. On the Y axis, the 5 factors (=Emotions) of the SEQ questionnaire.

Happiness: $r = 0.935$; $p < 0.001$), showing that they are indeed referring to the same construct (the emotions), while only their means are different right before and after exercise (see Table 4 for reference).

The objectives of the study were related to evaluate a short-term benefit of physical exercise on NCCD employees' general mood; notwithstanding, by plotting all the answers from each subject throughout all the sessions they've participated, we can observe that some of the participants had a general improvement of their general mood which had long-term effect (see Supplementary file, Figures 1–5). In particular, we can see that, amongst the participants who took part in our project's training sessions, subjects number 1 and 12 were the ones who most diminished negative mood at the end of the project's program, and if we consider only Anxiety, subjects 1, 12, 15, 16 and 18 had lower scores at the end of their participation. On the other hand, subjects 4, 5 and 17 tended to increase their positive mood levels; some of the volunteers participated too few times to the training sessions to be considered even as a tendency. Noteworthy, if we collapse all the subjects' answers in general plots, we lose this information and no tendency can be seen (see Supplementary file, Figure 6). Some of the subject did not take part to all the sessions, so it is not possible to conclude anything from these graphics, but there are some tendencies, which are worth a further, deeper investigation.

Qualitative data

At the end of the program (one week after) volunteers were asked some additional questions, which could give a feedback on what they thought about the project itself, if they liked sports or not and if they were aware of the benefits of the exercise on their emotional and psychological states. The results of this descriptive analysis show that: (a) 100% of the subjects liked the project; (b) 66.67% liked sports in general, 22.22% answered "More or less" and 11.11% don't like sports; (c) 100% recognize that exercise has a positive effect not only on physical health but also on psychological well-being; (d) 100% felt they gave different answers to questionnaires before or after the exercise. The open questions were about (e) why and how they think they answered in a different way reveal a general agreement on the fact that after the exercise their mood was more positive and they felt less anxious or worried (for example: "Most of the time I arrived at training with many problems … after the exercise I always walked out the door of the lab with a positive mood and motivated"; "I felt more stressed before training";

Table 4. *T*-Test comparisons applied on the means of the average value (for each subject) of the 5 Emotions and correlations between the same dimension before and after the exercise.

				Cronbach's α	
	t-value	Mean of Difference	Pre-post correlations (Pearson's *r*)	Our Sample	Jones et al. (2005)
1. Anger	4.137**	0.340	.54*	.94	.87
2. Anxiety	1.639	0.511	.85**	.89	.82
3. Dejection	1.734	0.646	.69**	.93	.84
4. Excitement	−6.113**	0.347	.95**	.93	.81
5. Happiness	−5.672**	0.342	.94**	.93	.88

Notes: Cronbach's α values for our sample and the original SEQ values as reported by Jones et al. (2005).
*$p < 0.5$.
**$p < 0.001$.

"I felt a change in the emotional state and a different attitude toward my colleagues"; "Many times I entered the lab very tense or annoyed from job issues and after training … it was gone!", etc.). The final question (f) obtained 94.44% of positive answer, as subjects declared that they want to keep on doing some kind of physical activity, since their emotional health can benefit so much from exercise; only the 5.56% answered "Maybe".

Discussion

The results showed here suggest that physical exercise might be effective in enhancing positive emotions in employees suffering for NCCDs and reducing negative ones, at least on the short-term. In particular, Anxiety levels diminished significantly after physical exercise, and positive emotions related to Excitement and Happiness increased significantly right after training (see Figure 2). As shown in previous reviews (Biddle et al., 2000; Biddle & Asare, 2011; Fox, 1999), the beneficial effects of physical exercise on Anxiety were controversial and generally, only mild changes have been found in literature. The present preliminary study follows the direction of these findings showing that, at least in our sample of employed adults with NCCDs participating to our local University project, Anxiety was significantly reduced right after taking part in a physical exercise work-based session, that means that there is an short-term beneficial effect of exercise on anxiety. Most importantly, we can observe a positive effect on Excitement and Happiness, and this appears to be in line with the discussion about the between positive emotions and well-being (Steptoe et al., 2009). The peculiar behavior of the Dejection and Anger data is noteworthy. We observed that in our dataset, frequently subjects had "0" as a mean score for them (both in Session 1 and 2), meaning that they may have experimented these emotions in a lower degree with respect to the other emotions, as it results from the reported scores. This could imply that data related to these negative emotions could be difficult to report for individuals through a self-report questionnaire, thus is less likely to detect changes from a baseline for these particular emotions, which was already low in the pre-training condition.

In Figures 1–5 of the Supplementary file, we plotted all the answers through the training sessions divided for each participant considering each of the emotions. Observing that data, it is possible to catch why there were no effects on Anger and Dejection: these two emotions were not so present in many subjects at any time of our study, and changes in the scores were so minimal that it was impossible to see any difference on the short-term (but also on the long-term). Something interesting emerging from these data is also that there are several participants who not only benefited of the physical activity at work the same day he/she had the training session (on the short-term), but also their baseline and general mood tended to improve slightly at the end of the project, showing that probably individual differences make the difference on the long run. In fact, it might be that some participants felt more positive emotions at the beginning because of the "new" experience, but then started to lose motivation. On the other hand, other volunteers really wanted to keep on training (in fact, they were the ones with more sessions), maybe because they liked how they felt right after the exercise and they observed improvements also in their own personal life. We believe that this might be due to individual differences (for example, personality traits or job-related

stress, or job satisfaction, etc.). All these issues deserve a deeper, dedicated study to be investigated.

The SEQ questionnaire, originally built as a competition-related screening measure (Jones et al., 2005), has been capable to capture the changes in the general mood of participants involved in a physical exercise program although we have used it with a difficult purpose, as we can observe comparing the reliability values of our measurements and the authors' ones (Table 4). In a further study, we aim to compare different emotion's questionnaires to assess their usability in contexts where emotions are investigated in an exercise-related activity, but are not referred to emotions about the physical activity itself.

One of the limitations of our study related to its small sample size ($n = 20$). Moreover, most of participants in the exercise plan were women. Although the tendencies described here are significant, confirmed by non-parametric tests and also, by additional parametric evaluations, they should be taken only as preliminary evidence. Further investigation with larger samples where male and females are equally represented is necessary to confirm the results obtained in this preliminary small sample aiming to an increased statistical power and generalizability.

Based on the limitations mentioned above, we are planning to develop a future study with a larger sample of workers (balanced by gender) and including different questionnaires for emotional state assessment or other related measures (including a subjective Quality of Life, or "QoL" questionnaire and a work-performance evaluation questionnaire, for example). Considering these results, it may be of great interest to investigate if this emotional and mood improvement right after exercise and training on workers affected by NCCDs (or other health conditions), actually felt better in their workplace when exercise was continuative and if their working performance also showed some benefits in addition to their general psychophysical gain. This way, occupational psychologists may take into account this kind of recommendation for institutions, i.e., to develop internal programs such as "active break" or "exercise break" to involve their employees and help in promoting a healthy lifestyle oriented to psychophysical well-being that can possibly represent a gain for both the employers and employees. This is what lead some Swedish companies (such as Kalmar Vatten, Rotpartner or Björn Borg) to go as far as making sports activities mandatory for their employees, aimed to obtain happier and more productive employees, and it also serves as a "social" enforcement, allowing them to get to know each other in a more equal and informal situation (Burns, 2018).

Conclusions

Health and well-being are extremely important factors in people's life as well as in the workspace (Danna & Griffin, 1999), and there are many ways to reduce potentially dangerous health-related issues which could harm employees' well-being, such as work-based physical activity and exercise, indoors (Grande et al., 2016; Shariat et al., 2017) or outdoors (Calogiuri et al., 2016), amongst other useful activities such as short meditation or biofeedback (Stein, 2001). This preliminary study directly quantified a pre- versus post-exercise difference in the employees' mood, showing that the exercise program in the workplace was effective in improving their short-term emotional state during their workday. These results support evidence that Chilean workplaces could take advantage of the new insights about the promotion of work safety and healthy lifestyle by means of short

exercise-based programs. Based on the limitations of this preliminary study, further investigation of these issues should address the following: (a) improvement of the experimental paradigm by adding a control group in order to perform crossed hypothesis testing; (b) increase the sample size, possibly reaching the same number of male and female subjects to evaluate possible gender differences on the observed effects; (c) add more questionnaires and tests for a better generalization and cross-methodological validation of the SEQ test (agreement with the other questionnaires on emotions, coherence and stability of the test in different situations or applications, correlation with personality and occupational performance measures and so on).

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No potential conflict of interest was reported by the authors.

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