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TITLE

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Abstract

Background. Several factors influence subjective well-being, and one of them is the rate of physical activity. However, the possibilities to perform physical activity are compromised by the running COVID-19 pandemic. Thus, the present study aimed to explore the relationship between self-reported physical activity levels during COVID-19 and subjective well-being. Furthermore, our secondary aim was to investigate whether personal well-being was different between men and women and between people with different self-reported physical activity levels.

Methods. Physical activity rate and subjective well-being were assessed using specific online surveys. Well-being was investigated using the 5-item World Health Organization Well-being Index while physical activity rates using the official Italian short form of IPAQ. Participation was voluntary, and people could fill the questionnaire simply by clicking on a specific link reachable via Social Networks or by email.

Results. The final sample size was 595 Italian responders. Male and female were equally distributed (50,3% male and 49,7% female). The multiple regression indicated that the model was a significant predictor of subjective well-being ($R^2 = .070$, $F(3,59) = 14,68$, $p < 0.0001$). The univariate ANOVA detected a statistically significant difference in subjective well-being perception between gender ($p < 0,05$; $\eta^2 = .01$) and among physical activity rates ((whole sample: $p < 0,0001$, $\eta^2 = 0,03$); Males: $F(2,296) = 4,364$, $p < 0,01$, $\eta^2 = 0,03$; Females: $F(2,293) = 5,256$, $p < 0,001$, $\eta^2 = 0,04$). Tuckey's post hoc identified a difference between Low active and moderate active males ($p < 0,01$) and low active and very active females ($p < 0,01$).

Conclusions. More vigorous activities are necessary for women to reach the goal of feeling good and satisfied with life than men. Therefore, women should be encouraged to spend more time practising physical activity at a more vigorous rate. This outcome might help practitioners set specific home training programs to be advised during periods of social life restrictions as the running COVID-19 pandemic.

KEYWORDS:

psychological health, inactivity, quarantine, active lifestyle,

TEXT

Introduction

Well-being is a positive outcome referred to people's feelings about life, relationships, emotions, resilience, and overall satisfaction(1,2). Generally, it includes positive moods (e.g., contentment, happiness), the absence of negative emotions (e.g., depression, anxiety), satisfaction with life, fulfilment, and positive functioning(3,4). However, even if well-being involves several aspects of human life and studied in different disciplines, physical well-being (e.g., feeling very healthy and full of energy) is considered critical to overall well-being(5,6). The ancient motto "mens sana in corpore sano" seems to be still alive nowadays, and, in this scenario, physical activity plays a key role(7). The evidence linking physical activity with enhanced mental health and well-being is now well described(8–10). According to the literature, participation in regular physical activity positively influences self-esteem and reduces stress and anxiety(11). Besides, it is the right way to prevent mental health problems, improving the quality of life and well-being of those experiencing them(9). For this reason, the World Health Organization (WHO)(12) promotes reaching a goal of 150 min/week of physical activity from the moderate-to-vigorous intensity. Physically active people experience less physiopathological and psychological problems concerning physically inactive ones(13,14), show higher well-being, are more productive at work and are more likely to contribute to their communities(1,15).

Unfortunately, in the first months of 2020, the severe acute respiratory syndrome Coronavirus 2 (SARS-COV2) spread globally, impacting people's lives on an unprecedented scale(16). Preventive

measures to fight the COVID-19 diffusion were adopted all over the world(17). Several states' most impacting action was to declare nationwide lockdown (including Italy) to adopt this solution(18). This condition restricted the possibility for people to move and closed non-essential business services (including recreation facilities, national parks, playgrounds, gyms, and sports venues). Citizens were relegated to their own homes as much as possible. Therefore, changes in physical activity habits and associated well-being should be expected in this scenario. To guarantee public health, the Italian government suggested people remain physically active directly at home performing exercises(19) through national television and relevant scientists(20,21). This situation of severe restriction might generate sedentary habits that could reveal critical for people's health. The so-called Sedentary Death Syndrome (SeDS) is a significant public health burden due to its causing multiple chronic diseases and millions of premature deaths each year(22). Thus, physical inactivity is a plague affecting our modern society, and a lockdown period might enhance this condition that might be more dangerous to people's health than the running COVID-19 pandemic. It is well-known that regular and moderate exercising improves antibacterial and antiviral immune surveillance, reduces inflammation, and delays immunological ageing(22,23). Therefore, spending the time forced at home by performing exercises is good prevention and curative tool for people's health. Physical activity could also be suggested in infected people. Maugeri and Musumeci(24) underline that maintaining physical and psychological well-being is vital for an infected individual to resume their health gradually. Adapted physical activity programs help people feel better physically and psychologically, even if infected by COVID-19 or forced at home.

On the other hand, the common fear for the disease, insecurity, significant reduction of social contacts, and perceived life changes are associated with higher mental impairments and negative behaviours(25). Thus, the present study aimed to explore the relationship between subjective well-being and the physical activity rate during COVID-19 restrictions and if this connection could be affected by participants' gender and age. Furthermore, as a secondary aim, this research tried to identify the variation of subjective well-being according to the physical activity rate and gender during the nationwide lockdown due to COVID-19. This study was conducted in the north-western Italian population using the short form of the International Physical Activity Questionnaire and the WHO-5 items questionnaire for well-being. The International Physical Activity Questionnaire (IPAQ) is a standardized tool used to assess the practice of physical activity in a population aged 18-79(26,27). In contrast, the WHO-5 questionnaire is used to assess subjective well-being(28).

Materials and methods

Study design and ethical considerations

This exploratory cross-sectional study reports data gathered between March 9 and April 10, 2020, using an online survey. The online questionnaire was created using the Google online survey platform (Google LLC; Mountain View, CA, USA). The link to the survey was sent to the participants via email and shared via social media (Facebook, WhatsApp, Instagram.). According to the manufacturer privacy policy (<https://policies.google.com/privacy?hl=it>), all answers were anonymous and confidential. This form was IP address case sensitive; therefore, nobody could submit another questionnaire from the same IP address once completed. Participants could abort or leave the questionnaire at any stage before the submission process. Participants had to submit the

form by clicking on the “*submit*” button, and a message with the sentence “*The survey was successfully submitted. Thank you for participating*” would appear. Unsubmitted questionnaires were not saved and not included in the database. The study was conducted following the Declaration of Helsinki and approved by the Institutional Research Ethics Board of the University of Turin (approval no. #251716).

Participants

Participants were recruited from our mailing list and via social media (Facebook, Instagram and WhatsApp), according to the following inclusion criteria: a) at least 18 years of age; b) living in Piemonte, Valle d’Aosta or Liguria (North-West of Italy); c) able to provide written consent for participation; d) able to understand written Italian. Responders living out of Piemonte, Valle d’Aosta, Liguria, or younger than 18 years old were excluded.

Outcome measures

The questionnaire included an introductory section with the background, the purpose of the study, and the anonymity and confidentiality declarations. At the end of this section, participants were asked to provide informed consent to participate in the survey. The questionnaire would not begin if the participants did not provide informed consent.

In the first section, the following demographics information were collected: gender, date of birth, body height, body weight, residence area (region, province and city), sport practised (if any) and years of practice (if any).

In the second section, participants were asked to answer the Italian version of the 5-item World Health Organization Well-being Index (WHO-5), a global rating scale that measures subjective well-being. (29) The WHO-5 comprises five items: (1) *“I have felt cheerful and in good spirits”*, (2) *“I have felt calm and relaxed”*, (3) *“I have felt active and vigorous”*, (4) *“I woke up feeling fresh and rested”* and (5) *“My daily life has been filled with things that interest me”*. The participants were asked to rate how each statement applies to them when considering the last 14 days using a six-point scale (5 = all of the time, 0 = none of the time).

The third section of the survey included the Italian version of the International Physical Activity Questionnaire - Short Form (IPAQ-SF) (30). The IPAQ-SF is a self-reported assessment of the time spent at different physical activity intensity in four domains: (1) work, (2) transport, (3) domestic and gardening, and (4) leisure time during the last seven days. This tool categorizes the physical activity levels as low, moderate, and vigorous-intensity (days/week, hours, and minutes per day) and records daily sitting time. From these values, it is possible to calculate the total amount and intensity of physical activities per week in terms of Metabolic Equivalent Tasks (MET), according to the following formulae: low activity (walking) = $(3.3 \times \text{walking minutes} \times \text{walking days})$; moderate activity = $(4.0 \times \text{moderate activity minutes} \times \text{moderate activity days})$; vigorous exercise = $(8.0 \times \text{vigorous activity minutes} \times \text{vigorous activity days})$ (www.ipaq.ki.se). Outcomes were classified into three categories: inactive (< 600 MET-min/w), moderately active (600-3000 MET-min/w) and active (> 3000 MET-min/w), according to the scoring system provided by IPAQ(26)

Statistical Analysis

Data were exported from the online forms to a Microsoft Excel spreadsheet and checked for outliers according to IPAQ guidelines (www.ipaq.ki.se). All data were analyzed using SPSS, version 19.0 (SPSS Inc., Chicago, IL, USA). Questionnaires that not met the inclusion criteria were not considered for further analysis.

Descriptive statistics ((mean and standard deviation (SD)) and count and percentage were used to present demographic data and levels of physical activity (low, moderate or vigorous). The participants' age was categorized as follows: young adult: <35 years old, adult: 35-64 years old, ≤65 senior adults. Multiple regression using the forward selection method in SPSS was utilized to investigate whether physical activity rate (MET-min/w), gender and age could significantly predict participants' subjective well-being. Besides, the stepwise forward selection was used to choose the fittest regression model to adopt for analyses. Finally, univariate ANOVA and Tuckey's post hoc analysis investigated subjective well-being variation according to the physical activity rate and gender. Levene's test to explore homogeneity of variance. Significance was assumed at $p < 0.05$.

Results

Participants' profile is shown in Table 1.

Eight hundred twelve subjects filled the questionnaire. However, 217 answers have been rejected because participants did not meet the inclusion criteria. Therefore, 595 responses were considered acceptable for further analysis.

Participants' gender was equally distributed between male (50,3%) and female (49,7%). The mean age was 30.47 (± 13.57); 72,4% of subjects were young adults, 25,7% were adults and 1,8% senior adults. According to WHO classification of weight status according to BMI ranges for adults(31), data indicates that 77.6% of the screened population was within a normal range ($21.72 \pm 1.7 \text{ kg}\cdot\text{m}^{-2}$) while 15.3% ($\text{BMI } 27.08 \pm 2.2 \text{ kg}\cdot\text{m}^{-2}$) overweight and 7.1% ($\text{BMI } 17.71 \pm 0.8 \text{ kg}\cdot\text{m}^{-2}$) underweight. (Table 1)

The rate of physical activity during the lockdown calculated by the IPAQ questionnaire indicates that 13.3% of the participants were classified as inactive subjects ($\text{MET} < 600$), 72.9% of moderate-active ($\text{MET } 600\text{--}3000$), and 13.8% active people ($\text{MET} > 3000$). (Table 1)

A multiple regression was carried out to investigate whether physical activity rate (MET-min/w), gender and age could significantly predict participants' subjective well-being. The results of the regression indicated that the model explained 7% of the variance and that the model was a significant predictor of subjective well-being, ($R^2 = .070, F_{(3,59)} = 14.68, p < 0.0001$). Furthermore, gender, physical activity rate (MET-min/w) and age contributed significantly to the model (gender: $\beta = .175, p < 0.0001$; MET-min/w : $\beta = .158, p = 0.0001$; age: $\beta = -.104, p < 0.01$). The final predictive model was: Subjective well-being = $53,159 + (.175 \cdot \text{gender}) + (.158 \cdot \text{MET-min/w}) + (-.104 \cdot \text{age})$.

Also, multiple regression was split according to gender. Age negatively influenced more female (age: $\beta = -.132, p < 0.01$) than male (age: $\beta = -.080, p < 0.05$). (Table 2)

The univariate ANOVA detected a statistically significant difference in subjective well-being perception between gender ($p < 0.05$; $\eta^2 = .01$) and among physical activity rates ((whole sample:

$p < 0,0001$, $\eta^2 = 0,03$); Males: $F(2,296) = 4,364$, $p < 0,01$, $\eta^2 = 0,03$; Females: $F(2,293) = 5,256$, $p < 0,001$, $\eta^2 = 0,04$)). Levene's test showed that the variances for gender considering the physical activity rate were equal ($p = 0,762$.), so homoscedasticity is accepted.

The Tuckey HSD post hoc run in the whole sample revealed that, independently from gender, inactive people meanly lose 6,53 point of well-being score ($p < 0,01$) versus moderately active and 11,14 points ($p < 0,0001$) versus very active responders. Moreover, moderately active meanly lose 4,61 points ($p = 0,054$) from very active people, showing a trend to a statistically significant difference. Table 3

Furthermore, the Tuckey HSD post hoc run in both gender groups revealed a significant difference in subjective well-being perception when considering inactive males (low physical activity) versus moderate active males (moderate physical activity) ($p < 0,01$; -8,52 points). Moreover, inactive male (low physical activity) versus very active males (vigorous physical activity) ($p < 0,05$; -10,44 points). No differences were detected comparing moderate and very active males ($p = 0,769$; -1,93 points). (Table 3; Figure 1)

Besides, Tuckey HSD post hoc identified a significant difference in subjective well-being perception when considering inactive females (low physical activity) versus very active females (vigorous physical activity) ($p < 0,01$; -11,35 points). Moreover, moderate active females (moderate physical activity) versus very active females (vigorous physical activity) ($p < 0,05$; -7,29 points). No differences were detected comparing inactive and moderate active females ($p = 0,276$; -4.06 points). (Table 3; Figure 1).

Discussion

The present study primary aim was to explore a possible relationship between subjective well-being and physical activity rate during the nationwide lockdown due to COVID-19 in the north-western Italian population. Secondly, our secondary aim was to investigate whether personal well-being was different between men and women and between people with different self-reported physical activity levels.

The sample description showed that the responders' most significant part was average weight, moderately active, and equally distributed genders(32).

The multiple regression model established a relationship between physical activity rate and subjective well-being. The more the physical activity is frequent and vigorous, the best people feel themselves. Even if with a small effect, our model identified this trend. Also, this model identified that age negatively affected subjective well-being. Moreover, age showed a slightly more robust impact on females than males. This outcome follows the current literature(29) that indicates more negative self-concepts and lower subjective well-being in women increases with age.

Furthermore, our results identified that subjective well-being is perceived differently between gender, considering the physical activity rate. Women are less satisfied than men. This outcome is hard to explain because it is still argued by the scientific community(33). Some studies report that usually, men have more life satisfaction(34) while others that women are generally "happier" than men(35). Finally, some authors identified no differences in subjective well-being perception between genders(36). However, none of them related to personal well-being with the practice of

physical activity. In the specific topic of physical activity, most of the present literature agrees with the thesis that support the non-significant differences in subjective well-being perception between genders(37,38). However, one study conducted in Italy during the nationwide lockdown found that the correlation between the reduction of physical activity and psychological well-being is more robust in the female group(39). Thus, the variations in physical activity habits due to COVID-19 restrictions could harder influence women's psychological status than men. On the other hand, our outcomes enlightened that, during the lockdown, moderately active female are less satisfied than men. Therefore, our results may agree with Maugeri and colleagues (35) study and confirm that females conveyed the reduction of physical activity due to COVID-19 restriction more than men. This fact is supported by the post hoc analysis run among different physical activity rates in females and males. A significant difference in males but not females was found matching the well-being questionnaire scores between low and moderate physical activity groups. These outcomes suggest that personal well-being is perceived similarly from inactive and moderately active women, while the situation is different, considering the opposite gender. Men subjective well-being differs from inactive to moderately active people. This scenario agrees with the findings of Maugeri et al. (39) that lower levels of physical activity have a more significant influence on females than males personal well-being and lead us to further considerations. Firstly, women needed more vigorous exercise to feel more positive and satisfied, while for men, it is sufficient to exercise moderately to reach the same goal. Secondly, our outcomes might suggest that female perception of exercise intensity might be different from men. This topic is still debated, and controversial

results have been reported(40–42). An interesting study led by Garcin and colleagues(40) on males and females middle-distance endurance-trained runners noted that the female runners perceived exercise as lighter and felt that they could endure more than the males for a given absolute training time. This information may explain our result, suggesting that the reduced time of physical activity caused by COVID-19 restriction has influenced more females than males. Therefore, specific home training advice should be set according to gender differences to guarantee high well-being levels in both men and women.

Concerning “vigorous physical activity”, results found that very active people showed the highest subjective well-being score. Independent of gender, very active people show a difference of meanly 11.14 points in the WHO 5-items well-being questionnaire. Following previous studies, this trend declared that regular engagement in physical activity programs is a buffer against depression and perceived stress, providing a better life satisfaction feeling (43). This research’s interesting results may also be found in the non-significant difference in well-being scores between moderate and very active males. On the other hand, the significance is very high between moderately active and very active women. This fact confirms the thesis previously discussed, asserting that for males is sufficient a moderate physical exercise to reach the goal of feeling better and more satisfied with life. At the same time, women need a more vigorous activity to come to the same target.

Finally, this study presents the following limitations. Firstly, this research used the short form of IPAQ intended for Social Networks (Facebook, Instagram, WhatsApp) and email. Thus, as is the case with any questionnaire, the respondents could have received more than one link or have experienced internet connection problems. Secondly, subjects were randomly reached through social networks or

public or private internet websites that spontaneously sponsored this survey. However, Social Networking sites are problematic for elders to use because of computer illiteracy, lack of knowledge of Web 2.0 concepts, and format, navigation, and layout issues(44). Thus, the higher prevalence of young responders may be due to this fact. Therefore, future research should investigate the elderly using the appropriate channels to reach them at best.

However, this study can give essential suggestions in the management of home training finalize to maintain a good perception of well-being and life satisfaction, particularly during great difficult moments like a pandemic or social life restrictions where mental health is undermined(25). Moreover, future studies should concentrate on the difference in exercise training intensity perception between genders to ensure specific physical activity guidelines.

Conclusion

As shown in the present study, subjective well-being differs considering gender and physical activity rate. The more the physical activity vigorous is, the greater is the perceived psychological well-being. Moreover, more vigorous exercise is necessary for women to reach the goal of feeling good and satisfied with life than men. On the other hand, a moderate exercise is enough to influence the well-being perception of men positively. Therefore, women should be encouraged to spend more time practising physical activity at a more vigorous rate. Finally, home training for men and women should not be the same if the target is improving life satisfaction and personal well-being. This outcome might help practitioners set specific home training programs to be advised to men and women during periods of social life restrictions as the running COVID-19 pandemic.

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Conflict of Interest

The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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Authors' contribution

Federico Abate Daga and Luca Beratto have contributed to the manuscript's conception and design and supervised the experimental phase. Samuel Agostino and Serenella Peretti conducted the experiment, performed the calculations and organized tables and graphs. Finally, Federico Abate Daga wrote the manuscript with input from all authors. All authors read and approved the final version of the manuscript.

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FIGURES AND TABLES

			Physical Activity rate(PAr) groups					
			Low tot=13.3%		Moderate tot=72.9%		Vigorous tot=13.8%	
Variable	Category	% in whole sample	% in PAr group	Mean Met	% in PAr group	Mean Met	% in PAr group	Mean Met
Gender	Female	50,30	17,50	386,84	60,10	1540,34	22,40	3582,97
	Male	49,70	13,20	312,44	63,50	1574,09	23,40	3747,66
Age groups (years)	Young adults	77,30	12,2	358,07	73,50	1554,75	14,30	3791,23
	Adults	18,50	15,5	362,71	71,8	1553,77	12,70	3511,50
	Senior adults	4,20	24,0	302,17	68,00	1630,06	8,00	3210,00
BMI groups	Underweight	7,10	14,00	231,67	62,80	1628,50	23,30	3254,17
	Normal weight	77,60	14,90	369,72	60,90	1573,24	24,30	3682,13
	Overweight	15,30	18,70	342,92	65,90	1453,85	15,40	3922,57

Table 1 Distribution of Individual Characteristics of the whole sample (n = 595) and physical activity rate groups (low, moderate, vigorous).

Predictors	Whole sample (n=595)				Male (n=299)				Female (n=296)			
	β	95% CI		p	β	95% CI		p	β	95% CI		p
Gender (male vs female)	,175	3,284	8,593	,000								
IPAQ MET	,158	-,228	-,032	,000	,138	-,231	,040	,166	,179	-,314	-,025	,022
Age	-,104	,001	,004	,009	-,080	,000	,004	,016	-,132	,001	,005	,002

a. Dependent Variable: Well-Being Score $R^2 = ,070$, $F = (3,591) = 14,681$

Table 2. Representation of the multiple regression model chosen with stepwise forward selection.

	Physical activity rate	MET- min/w (mean)
All sample	Low	50,36
	Moderate	56,64
	Vigorous	61,26
Male	Low	51,65
	Moderate	60,16
	Vigorous	62,09
Female	Low PA	49,07
	Moderate	53,13
	Vigorous	60,42

Table 3. Representation of the mean of MET consumption in the three physical activity rate group and relative gender

Physical activity rate				
All sample (n=595) F=8,758, p<0,001 $\eta^2=0,03$	I	J	mean diff (I-J)	p=
	Low	Mod	-6,53*	0,004
	Mod	Vig	-4,61	0,054
	Low	Vig	-11,14*	0,0001
Male (n=299) F=4,364, p<0,05 $\eta^2=0,03$				
	Low	Mod	-8,52*	0,018
	Mod	Vig	-1,93	0,769
	Low	Vig	-10,44*	0,02
Female (n=296) F=5,256, p<0,001 $\eta^2=0,04$				
	Low	Mod	-4,06	0,276
	Mod	Vig	-7,29*	0,029
	Low	Vig	-11,35*	0,004

*dependent variable well-being score

Table 4. Description of the univariate ANOVA of the whole sample and split by gender with relative Tuckey's post hoc.

Figure 1. Well-being score calculated using the WHO-5 items questionnaire during COVID 19 nationwide lockdown. Data are expressed as mean and SD according to gender and Physical Activity (PA) rate group (Low PA <600 MET-min/w; Moderate PA 600-3000 MET-min/w; Vigorous PA >3000 MET-min/w). A significant difference ($p < 0,01$) was identified between Low PA and Moderate PA male groups and ($p < 0,01$) between Low PA and Vigorous PA female groups.

