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Physical activity levels across COVID-19 outbreak in youngsters of Northwestern Lombardy

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ABSTRACT

BACKGROUND: Italy early experienced one of the most suffering impact of the COVID-19 outbreak in terms of number of cases and death toll. Progressively, more compelling national restrictions hardened citizens' lifestyle and habits, including limiting mobility and outdoor physical activity (PA). In a second phase, people were allowed to perform outdoor activities close to their houses and thereafter motor or sports activity were gradually reintroduced. These drastic changes raised the question on how to cope and exploit the residual opportunities of PA under circumstances of home confinement.

METHODS: International Physical Activity Questionnaires were administered to 1,568 youngsters from North-western Italian high schools, before, during, and after lockdown enacted by Italian Government to contrast the COVID-19 pandemic.

RESULTS: Student's PA levels were significantly different before (1676.37 ± 20.6 MET-min/week) and after (1774.50 ± 33.93 MET-min/week) the governmental restrictions (TIME effect: $F=3.49$; $\eta_p^2 = 0.005$ $p=0.03$). There was a significant TIME*CATEGORY interaction effect ($F=8.37$; $\eta_p^2 = 0.021$; $p<0.001$). In particular, only highly active students (≥ 2520 MET-min/week) increased their PA during (3467.48 ± 55.85 MET-min/week) and after (3515.73 ± 65.75 MET-min/week) the lockdown measures with respect to their baseline levels (3151.43 ± 42.41 MET-min/week).

CONCLUSIONS: Lockdown measures, including isolation, impacted negatively on the PA levels of the already inactive or moderately active young population. Government actions should enhance strategies to control physical inactivity during pandemics like COVID-19.

Keywords: IPAQ, social distancing, home-based physical training

Introduction

Italy has been one of the European epicentres of the COVID-19 pandemic. Since the first discovery of this novel beta coronavirus (SARS-CoV-2) in Wuhan – Hubei province of China – in December 2019¹, the related outbreak rapidly expanded worldwide, and the World Health Organization (WHO) declared this disease “COVID-19” as pandemic². Italy suffered one of the deadliest impacts of coronavirus, with a high crude case-fatality ratio in Lombardy, 18.3%, whereas in the rest of Italy was 10.3%³. In fact, Lombardy, the most densely populated region of northern Italy, faced an epidemiological scenario completely different from the rest of the nation, in terms of larger number of confirmed cases and victims. When initial clusters were identified, restrictive actions to curb isolated upsurges of infection were taken by the regional health system of Lombardy and, thereafter, were extended to all northern Italy and to the entire country.

While home isolation has been imposed as an obvious measure to avoid interhuman contact and therefore interrupt virus transmission, other restrictive actions were taken to contain COVID-19 pandemic. Specifically, two subsequent Decrees of the Italian government, on March 11⁴, and March 22, 2020⁵, initially limited and then abrogated any nonessential movement, including outdoor sports and motor activity, with the exception of activities practiced around a 200 m home-block area and provided at least 1-m of interhuman distance. To a certain extent of similarity, other countries’ governmental authorities, in agreement with their healthcare systems, adopted restrictions that impacted citizens lives on different levels.

Mass quarantines (“lockdowns”) payed a dramatic psychosocial⁶ and economic cost. Social distancing was naturally associated with reduced levels of PA: home residing could augment sedentary behaviors (sitting time, watching-tv, using smart-devices) or at least bring energy expenditure lower than usual. In turn, this could lead to the worsening of chronic diseases such as obesity, type 2 diabetes, hypertension and the deleterious effects of aging (frailty, sarcopenia, cognitive impairment).

Although exacerbated by COVID-19 healthcare policies, physical inactivity could be considered as a *pandemic* itself, being identified by WHO as the fourth leading risk factor for global all-cause mortality, causing 6-10% of all deaths from the major non-communicable diseases ^{7,8}. Former reports on COVID-19 underpinned that individuals of an older age with multiple comorbidities are more inclined to manifesting severe complications following infection by SARS-CoV-2 and have an increased risk of mortality ⁹. However, authorities' anti-COVID-19 actions perturb individuals' mental and physical health, regardless of their age, especially those who regularly practise outdoor physical activities ^{10,11}. Even young adults and schoolchildren may be tremendously affected by lockdown-sedentariness, given they rely significantly upon physically active peer interactions for their general wellbeing.

Ultimately, the need to maintain regular PA levels is still urgent during a health emergency, even if an asymptomatic SARS-CoV-2 infection has been ascertained ¹² and to prevent complication related to chronic disease such as diabetes and obesity ¹³⁻¹⁵. In fact, PA has been shown to be a very effective strategy, given the immune-modulatory effects of exercise which are an essential forefront, on a standard basis ¹⁶, and especially under circumstances of obliged sedentariness/forced home confinement ^{17,18}.

Within this uncharted scenario, the present study explored the PA levels of youngsters of North-western Italy across COVID-19 outbreak. To this end, validated questionnaires were administered thrice: 1) at end of January 2020, before the first Italian COVID-19 case was diagnosed in southern Lombardy (February 21); 2) during the lockdown measures imposed by Italian Government (March-April); 3) when these COVID-actions were lifted (May) therefore all activities, including sports, could be pursued up to normality. The overall aim was to describe the PA patterns, and the impact of isolation measures on them, originating from an emblematic Italian population involved in COVID-19 pandemic.

Material and Methods

Procedure and participants

This cross-sectional study recruited Italian youngsters aged 15-18 years from Northwestern Lombardy high schools (Brianza area). Data were collected with an online¹⁹ version of International Physical Activity Questionnaire (IPAQ) written in Italian language²⁰ and administered thrice, between the 27th January 2020 to the 10th May 2020. In detail, IPAQs were filled before the Italian measures of lockdown (January 27-31); during the lockdown (April 4-10) and after (May 4-10). Participants were involved by the head of the Physical Education teachers. All participants were informed of the general purpose of the study and data were collected anonymously. Actually, prior to COVID-19 outbreak, IPAQ administration was planned as a routine monitoring of the students' PA levels. Researchers provided written informed consent to the students before participating in the study. The time needed to complete the survey took approximately 10 minutes. Collected data were coded and processed anonymously. The Department of Psychology of Development and Socialization Processes Ethical Committee of University "La Sapienza" approved the study. The sample was composed of 1568 participants.

Data analysis

All data were presented as mean (m) \pm standard deviation (sd).

The Gaussian distribution of the data was ascertained by skewness and kurtosis indexes, both within the conventional cut-off²¹.

A 3x3 (analysis of variance) ANOVA was performed considering the MET-min/week as the dependent variable, a first three levels' factor namely "CATEGORY" (inactive <700 MET-min/week, moderate between 700 and 2519 MET-min/week and intense \geq 2520 MET-min/week; according to the cut off established by the Italian IPAQ short form²²), and a three levels' TIME factor (pre, during, post). The model was corrected as the Levene's test of equality of error variances was significant. For all analyses, a p-value less than 0.05 was considered statistically

significant. For all analyses, a p value less than 0.05 was considered statistically significant. Partial eta squared (η_p^2) effect sizes (ES) were determined and interpreted using the following cut-offs: small effect, $\eta_p^2 \leq 0.03$; medium/moderate effect, $0.03 < \eta_p^2 < 0.10$; large effect, $0.10 \leq \eta_p^2 < 0.20$; very large effect, $\eta_p^2 \geq 0.20$ ²³.

Analyses were carried out with the Statistical Package SPSS version 26 for Mac (Armonk, NY, USA; IBM Corp.), GraphPad Prism 8 (San Diego, CA, USA), and Excel version 16.32 for Mac (Microsoft, Redmond, WA, USA).

Results

PA levels from IPAQ are showed in Table 1 and Figure 1 and 2. Specifically, when PA levels were expressed as MET-min/week (Fig. 1), the ANOVAs showed a significant main effect for the TIME factor ($F=3.49$; $\eta_p^2 = 0.005$ $p=0.03$). Pairwise comparisons demonstrated a significant difference between PA levels performed before ($m_{pre} = 1676.37$; $sd = 20.6$) and after ($m_{post} = 1774.50$; $sd = 33.93$) the governmental restrictions, and a not significant effect between during and pre, or during and post governmental restrictions.

Considering the interaction between TIME*CATEGORY, there was a significant interaction effect ($F=8.37$; $\eta_p^2 = 0.021$; $p<0.001$). Pairwise comparisons showed that there were significant effects between “pre” and “during” ($m_{pre}=3151.43$; $sd = 42.41$; $m_{during}=3467.48$; $sd = 55.85$; $p<0.001$), and “pre” and “post” ($m_{pre}=3151.43$; $sd = 42.41$; $m_{post}=3515.73$; $sd = 65.75$; $p<0.001$) only the for the highly-active students (i.e. “intense” ≥ 2520 MET-min/week).

A similar pattern of results was obtained analysing the different gender of the participants, either per absolute PA levels or categorial PA levels (Supplementary Table I).

Comparing the students' PA levels, as determined by the IPAQ scoring, in relation to the WHO recommendations for children and adolescents, the fulfilment of WHO for being considered

as “physically active” was scarcely prevalent before the Italian lockdown (~6%); it increased during the lockdown and when overall activities were reinstated (~14%) (Table 2).

Discussion

According to the World Health Organization (WHO) and the American College of Sports Medicine (ACSM) ²⁴, everyone should meet the 150 minutes of weekly moderate-to-vigorous activity guidelines (or at least 75 minutes of vigorous intensity aerobic PA) as a critical component of a healthy lifestyle. These recommendations were challenged by the COVID-19 pandemic, as worldwide measures were taken to reduce virus transmission, affecting public and healthy lifestyles, dramatically. Moreover, social distancing and isolation may complicate the accomplishment of this recommendation for children and adolescents, given their usual active social interaction with peers. In this regard, WHO recommendations for children and adolescents encourage to fulfil 60 minutes of daily moderate-vigorous intensity PA to promote psychological benefits and assisting in social development by providing opportunities for self-expression, building self-confidence, social interaction and integration ²⁵. In this study, PA levels were indirectly assessed with an online questionnaire in a representative cluster of north-western Italian young students, prior to, during, and following, government measures of lockdown. As a secondary endpoint, the comparison of PA adherence might reflect the psychosocial impact of home confinement on general wellbeing.

Similarly to the current investigation, other studies ^{15,26}, conducted at national level, examined the modifications of the PA levels occurred during self-quarantine. Recently, we published an extensive national survey on a cross-sectional population, outlining the psychological mechanisms affecting PA practice under the circumstances of the COVID-19 outbreak ¹⁰. Through ~~a~~ structural equation modeling, we found that anxiety was significantly higher in the Lombardy region (where Brianza area is also located) than the rest of the country. Differently from other reports, the present study exhibited two diverse responses, according to the categorial PA levels:

those who were previously inactive-, or moderately active, increased their sedentariness during and after the COVID-19 closures, whereas highly active youngsters reacted vigorously to the pandemic by augmenting their PA levels during and following the national restrictions. These latter results confirm a profound modification of students' usual lifestyles and habits during throughout the COVID-19 public health emergency. Particularly, their willingness to pursue in being physically active during lockdown measures is consistent with a predominant effect of the past behaviour, as already ascertained in larger-sample study ¹⁰. These students might be more psychologically flexible ²⁷ while maintain greater levels of PA. A usually high PA routine might have offered a partial resilience. However, a multitude of emotional factors may intervene during a lockdown period. The imposed restrictions affected the lesser active students inevitably primarily by inhibiting their participation in the recommended levels of PA, especially considering the suspension of Physical Education curricula. Basically, inactive students unchanged their PA levels throughout the experimental timeframe. One may posit that those students with low-PA levels insufficiently adhered to the online tutorials and/or home-based physical activity programs. In fact, such strategies were implemented as a compensation for obliged physical inactivity while alleviating anxiety and stress conditions experienced during the COVID-19 lockdown.

Given that high levels of moderate intensity PA may eliminate the increased risk of all-cause mortality associated with high sitting time ²⁸, these results may be useful for public health guidelines targeting the deleterious effects of sedentary behaviors. Fulfilling the recommended levels of daily PA is well-established to aid health development in school-aged children and adolescents, as well as protecting from early onset of chronic diseases. In front of the continuous spreading of COVID-19 globally, public health authorities, school administrators, teachers and parents should be aware not only of the protective measures to avoid virus transmission, but also of other hygienic measures to maintain physical fitness ²⁹, boosting immune system and mitigating the negative effects of isolation.

Limitations

The impossibility to couple data impeded application of a structural equation modelling with a latent growth curve. Nevertheless, this anonymous online questionnaire was an easy and rapid method to involve participants by means of a survey. Respondents' compliance was positive, especially considering the critical moment – *ipso facto* difficult for the interviewed youngsters.

The decrease of the group sample sizes throughout the observed timepoints limited the accuracy of the analysis, however the design could not have been changed *in itinere*.

Other intrinsic variables such as socio-economic status (SES) of the participants could have more precisely described the sample and the possibility to have adequate contexts to remain active.

Nevertheless, a rapid and direct approach with the students to meet their full compliance was preferred, avoiding unverifiable information.

Indirect measures such as these yielded by IPAQ questionnaires are only partially informative of the actual PA levels and the related underlying psychosocial mechanisms impacting on the surveyed youngsters. However, in a different study these peculiar psychosocial traits could be depicted and debated under proper theoretical perspectives ¹⁰.

Conclusions

This small-scale study attested to an increase of physical activity among highly active Italian school adolescents during and after the COVID-19 quarantine period enacted in spring 2020. On the contrary, those students who were inactive, or moderately active, unchanged their PA levels across the COVID-19 lockdown.

Novel public health and wellbeing models should be developed for a general preparedness and facing health and social emergencies. During expected long home stay, multi-structured interventions, even technology-based, should be outlined in order to maintain regular levels of PA, and therefore mental health and immune functions. Finally, to face less possibilities to exercise,

specific programs with online trainings and tutorials on how to maintain an active lifestyle should be developed in school settings.

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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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None.

Authors contribution

MT and NL contributed to the conception and design of the work; MT, NL, MV and RC completed the acquisition; analysis and interpretation of data for the work were computed by AC and RC; RC drafted the work; MT, NL, MV, AC and RC revised it critically for important intellectual content.

All authors read and approved the final version of the manuscript.

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Table I. PA categorial level of the surveyed participants across the COVID-19 phases.

	COVID-19 phases					
	pre		during		post	
	n	%	n	%	n	%
PA levels						
inactive	154	17.8	102	25.8	53	18.5
moderate	573	66.3	214	53.6	177	61.7
intense	137	15.8	79	19.8	57	19.9

Table II. Students fulfilling WHO recommendations according to IPAQ scoring.

		WHO (1, 2) * ≥ 60 min/day moderate-vigorous PA	WHO (3) * ≥ 3 times/week vigorous PA	WHO (1,2,3) *
	Total n	n (%)	n (%)	n (%)
Pre	864	59 (6.8)	342 (39.6)	51 (5.9)
During	395	58 (14.7)	198 (49.9)	56 (14.4)
Post	287	43 (15.0)	238 (82.9)	39 (13.6)

* *Who recommendations for children and adolescents:*

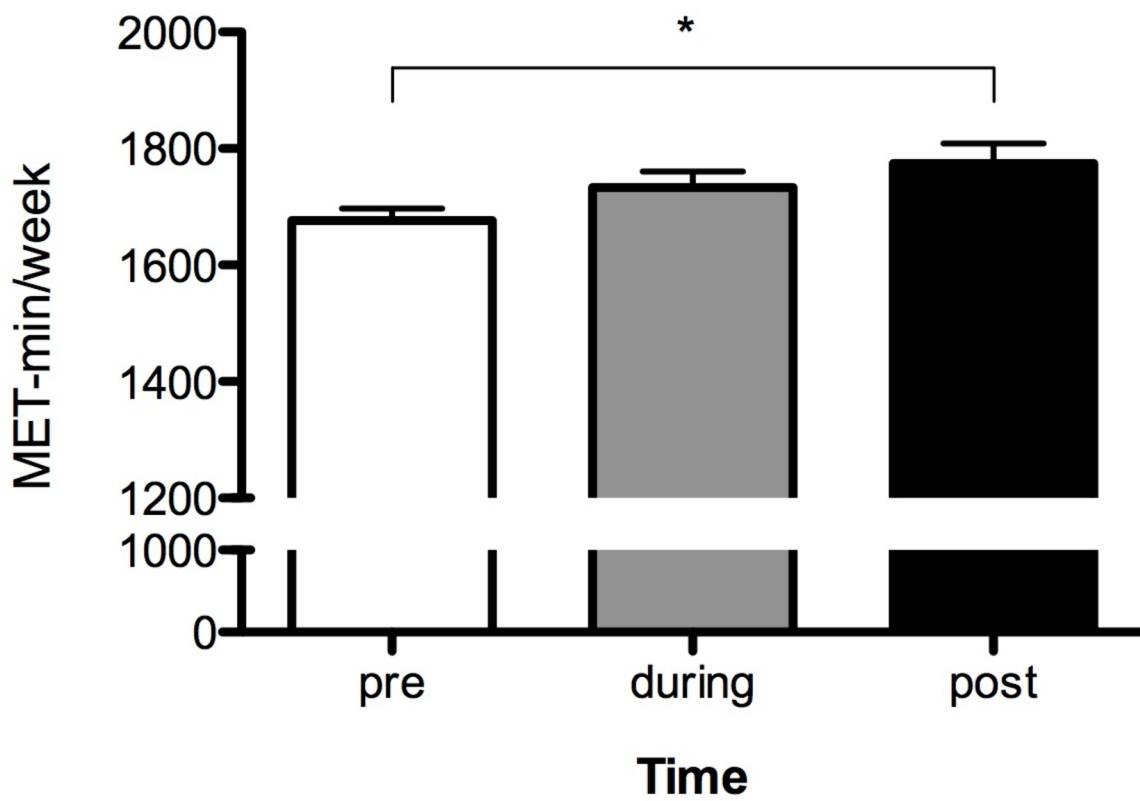
1) *Children and youth aged 5-17 should accumulate at least 60 minutes of moderate-to-vigorous intensity PA daily; 2) Amounts of PA greater than 60 minutes provide additional health benefits; 3) Vigorous-intensity activities should be incorporated at least 3 times per week.*

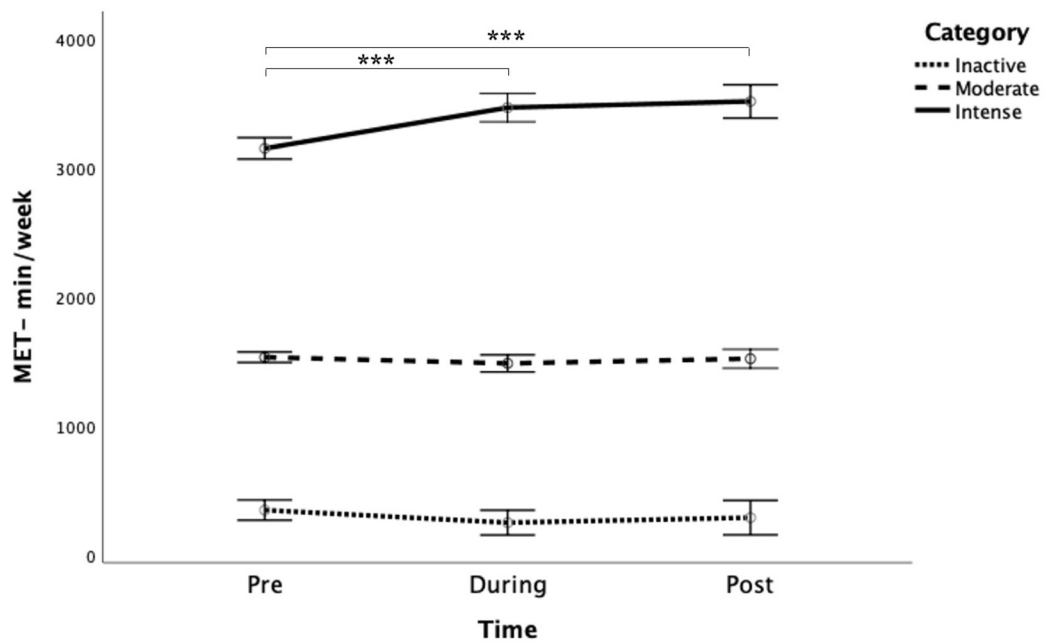
Figure 1. Physical Activity levels (MET-min/week) of youngsters of North-western Lombardy, prior (white bar), during (grey bar) and following (black) the lockdown period imposed by Italian governmental authorities due to COVID-19 outbreak.

* $p < 0.05$

Figure 2. Participants' categorial levels of physical activity (MET-min/week) prior, during and following the lockdown period imposed by Italian governmental authorities due to COVID-19 outbreak.

*** $p < 0.001$





Supplementary Digital Material

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