Coronavirus disease (Covid-19): How does the exercise practice in active people with type 1 diabetes change? A preliminary survey

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ABSTRACT

Aims: Coronavirus disease (Covid-19) could lead persons with pre-existing medical conditions to severe respiratory infections. The Italian Government introduced quarantine to limit viral transmission. This measure could lead people with type 1 diabetes (PWT1D) to disrupt daily care routine including PA practice with difficulties in glycemia management. This study aims to explore PA level in PWT1D before and during quarantine and to describe variation in glycemia values.

Methods: An online survey investigating medical factors and the perceived and PA level in pre-established period before and after the introduction of quarantine was developed. Comparison between pre and post quarantine was assessed by Wilcoxon Signed Ranks test for continuous variables.

Results: A total of 154 subjects satisfied the eligibility criteria (54.5% males, 44.8 ± 12.5 years). We found a decrease of PA level (Godin Scale Score 25 ± 1.7vs38.6 ± 1.7 points), steps number and minutes of exercise (respectively 12.606 ± 5026vs4.760 ± 3.145 and 66±4 vs 38 ±3) and an increase of glycemia values (142.1 ± 25.4 mg/dLvs150.8 ± 29.4 mg/dL).

Conclusions: PWT1D reported a decrease in exercise and worst glycemia. Although PWT1D tried to remain active, their PA level was inadequate to prevent glycemia rising. The difficult to maintain a glycemic control could expose patients to diabetes complications and to an higher risk to counteract infections.

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1.   Introduction

The on-going Coronavirus disease (Covid-19), an acute infectious respiratory that could lead to a severe pneumonia till to death, has become the world's leading health headline causing public concerns [1,2]. On January 30, 2020, the World Health Organization (WHO) declared that the new coronavirus outbreak is a public health emergency [3]. Further, on February 22, 2020, the Covid-19 expanded in Italy causing the largest and deadly epidemic in the Country [4]. WHO warned that the most at-risk populations are older and people with pre-existing medical conditions such as high blood pressure, heart disease, lung disease, cancer and diabetes [5].

In particular, people with type 1 (PWT1D) and poor glucose control, in particular high glycated hemoglobin (HbA1c) or/ and insulin resistance, showed higher risk to counteract infections due to the impaired body immune response, this also holds true with Covid-19 [6,7]. For this reason, PWT1D should manage blood glucose levels with frequent glycemia controls and subsequent insulin delivery adaptations and improving their life style to prevent serious illness [8]. Moreover, it seems that the routine care of diabetes that included also diet and physical activity (PA) were disrupted during the current pandemic, these may contribute to worsening outcomes [9–11]. In accordance to Istituto Superiore della Sanità (ISS), the Italian Government implemented extraordinary measures to limit viral transmission throughout people and the territory, imposed national quarantine, reduced social interaction and travelling and "stay at home" as a basic means of limiting people's exposure to the virus [12]. Unfortunately, the mandated restrictions on travel and on participating in outdoor activities, including regular PA and exercise, inevitably disrupted the daily routine activities of millions of people [13,14]. Although containing the virus spread remains a priority, it is also necessary to act on multiple aspects of public health. Unfortunately, few public health guidelines for the public in terms of maintaining daily exercise or PA routines were developed [15]. PWT1D have been advised to follow general guidance on risk reduction, including social distancing and were emphasized the importance of good glycemic control. The major strategies to control glycaemia levels and reduce the risk of hyper or hypoglycemia are: more frequent blood glucose monitoring, diet and maintain the regular practice of PA [11,16–19].

We hypothesize that quarantine reduced social and environmental exposure and consequently PA practices (gym and outdoor activities) with possible health impairment. In particular, in PWT1D, even in active people, the reduction of PA could have altered euglycemia maintenance. Regular and safe exercise practice should preserve good psycho-physical wellbeing and the protective effects of it. Despite the closure of green areas, gyms and swimming facilities, we assume that an increased use of technology, such as specific training channels, applications and resources posted on social media could help people to train at home. The aim of this study is to explore the PA level in Italian people with type 1 diabetes before and after the national quarantine introduced to contrast Covid-19 disease and describe variation in glycemia values.

2.   Material and methods

2.1.   Sample and study design

We conducted an observational study. PWT1D were recruited through an online survey developed by Sport scientists and Diabetologists through SurveyMonkey software (SurveyMonkey inc 2020, California, Usa) in Italy. The inclusion criteria for PWT1D were age$\geq$ 18 years, HbA1c $\leq$ 86 mmol/mol ($\leq$ 10%) and the capacity to understand Italian language. The exclusion criteria were uncontrolled diabetes, comorbidities that do not allow exercise practice, ongoing Covid-19 infection and cognitive impairments. Participants were asked to fill out a survey consisting of multiple features referred to two periods: before the outbroken of Covid-19 disease and after the introduction of national quarantine. All the participants were asked to completed the written informed consent to the threat of data before to be enrolled in the study: "We guarantee the confidentiality of the information collected according to Regulation (EU) / 2016/679 GDPR (Regulation (EU) 2016/679), Legislative Decree n.101 / 18." The study procedure was approved by Internal Ethical Board of University of Pavia. The study protocol was in accordance with the principles of the Declaration of Helsinki as revised in 2008.

2.2.   Measures

Anthropometric characteristics such as body weight (kg) and height (m), socio-demographical outcomes and medical factors such as the duration of disease (yrs) and the self-reported values of the last (mmol/mol;%) HbA1c were collected by online survey to describe the sample. PA level was investigated into pre-established days before the outbreak of Covid-19 disease (11–12-15 February) and after the introduction of national quarantine (17–18-21 March). The perceived PA level was explored through the Godin-Leisure Time Exercise questionnaire [20]. The Godin-Leisure Time Exercise questionnaire is a self-reported questionnaire that investigated leisure activity during a 7-day period of different intensity exercise (strenuous, moderate and light). The Weekly Leisure Activity Score was previously described by Godin et al (2011). To obtain PA level, we ask to report the number of steps and minutes of exercise of subjects with an activity tracker (AT).

2.3.   Medical outcomes

Patients reported their glycaemia values (mg/dl) through the mean values (7 days) showed by system connected to continuous glucose monitoring in the two periods of the study: two weeks before and two weeks after quarantine beginning. Then, the modifications of subjective perception of metabolic compensation (optimal, good or low) before quarantine while glycemia trend (ameliorated, stable, worsted with glycemia

rising and/or glycemia fluctuation) and changes in insulin delivery (stable, increase or decrease) during quarantine were investigated.

2.4. Statistical analysis

Quantitative variables were expressed by mean ± standard deviation (SD) and qualitative variables by frequencies or percentage as appropriate. The assumption of normality of data was tested by Shapiro-Wilk test. Comparison between pre and during quarantine was assessed by a Paired *t*-test and Wilcoxon Signed Ranks test for continuous variables. A p-value of <0.05 was considered statistically significant. All analyses were performed using STATA 13 software.

3. Results

A total of 188 PWT1D answered to the survey. The quality control of data was made in order to evaluate discrepant responses, missing data and ineligibility criteria. A total of 154 subjects satisfied the eligibility criteria (Fig. 1).

The 54.5% of sample was males, the mean age was 44.8 ±12.5 years. The mean height and weight were 1.70±0.1 m and 70.7±13.5 and the mean BMI was 24±3.7 Kg/m² (Table 1). In the period before the quarantine 90.9% practiced exercise in different modalities (36.4% in autonomy), during the quarantine 82.5% maintained exercise in autonomy. Table 2.

Godin Scale Score showed an active PA level (score greater than 23 points) both in pre and during quarantine, but during quarantine we observed a significant decrease (25±1.7 points vs 38.6±1.7 points recorded pre quarantine; p<0.001). We observed, also, a significant increase in the mean values of glycemia during the quarantine (pre quarantine 142.1± 25.4 mg/dL vs during quarantine 150.8±29.4 mg/dL; p<0.001) (Table 3).

Further, we investigated the variation of perceived metabolic compensation and the insulin delivery finding that during the quarantine the 41.9% of PWT1D perceived worst metabolic compensation due to increased glycemia mean values and glycemic variability; 63.9% of PWT1D had to modify

Table 1 – Anthropometrics' and socio-demographical characteristics of the whole sample.

Outcomes	Participants n = 154
Age (year)	44.8 ± 12.5
Sex (males)	84 (54.5%)
Height (m)	1.7 ± 0.1
Weight (Kg)	70.7 ± 13.5
BMI (Kg/m2)	24 ± 3.7
HbA1c (mmol/mol; %)	52.0 ± 0.9; 6.9 ± 0.9%
Work, n.(%)	
Student	13 (8.4%)
Sedentary worker	92 (59.7%)
Active worker	49 (31.8%)

the insulin delivery and, in particular 32% of them, had to modify both the basal and rapid dosage. (Data not shown).

3.1. PA level from AT

The sub-sample of 100 subject with AT confirmed a low PA level during national quarantine; in fact, we found a decrease in steps number and in minutes of exercise (respectively 12.606 ±5026 vs 4.760±3.145 steps number; 66±42 vs 38±31 min of exercise; p<0.001). Also glycemia and GSS follow the same trend of whole sample (Table 4).

4. Discussion

The Covid-19 pandemic is considered the worst public health concern in the last decades that resulted the largest and severest measures to contrast the diffusion of the disease [2]. People of all ages risk to counteract this virus but the most at-risk populations are older and people with pre-existing medical conditions such as diabetes [5]. People with uncontrolled type 1 diabetes showed higher risk to get infections so they should manage blood glucose levels as close as possible to their goal to prevent serious complications related to the disease such as onset and progression of microvascular (neuropathy, nephropathy and retinopathy) and macrovascular complications [6]. The movement limitations imposed by Italian Government created difficulties to patients in maintaining routine care with limitation of option of PA and more complex management of diabetes [8,15]. In our study, PWT1D reported a significant decrease both perceived and measured PA level and an increase of glycemia values during the national quarantine. In particular, more than 42% of patients reported a worst perceived of metabolic compensation and more than 62% of patients underlined a worst glycemia management and the necessity to modified insulin delivery.

Many researches supported the role of PA practice to maintain the euglycemia state and to reduce the glycemic rebound helping patients to better manage diabetes [11,17,19,21,22]. The increased difficult to maintain good glycemic control could expose patients to general diabetes complications and, in particular, to higher risk to counteract infections.

Diabetologists had to advise patients to ameliorate diabetes control and suggested the strategies to pursue this aim. However, in this period, the entire health system was
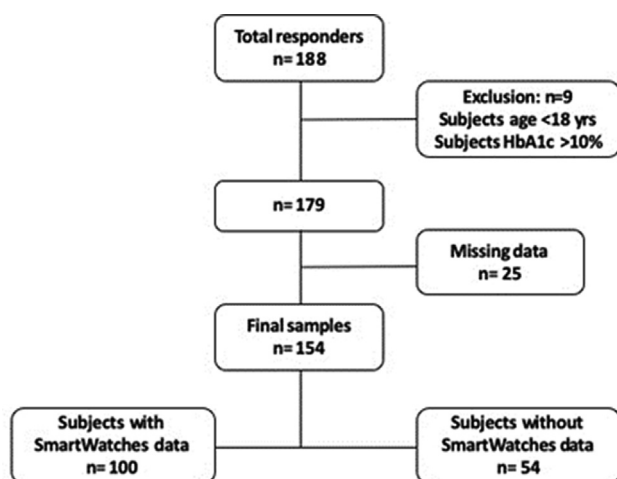

Fig. 1 – Study selection process.

Table 2 – Exercise practice differences between pre and during quarantine.

Sample (n = 154)	Pre quarantine	During quarantine
Type of exercise, n (%)		
Individual sport	55 (35.7%)	–
Team sport	7 (4.5%)	–
Fitness	16 (10.4%)	–
Resistance training	6 (3.9%)	–
In autonomy (App/social)	56 (36.4%)	127 (82.5%)
None	14 (9.1%)	27 (17.5%)

Table 3 – GSS and glycemia pre and during the quarantine (n = 154). All values are shown mean ± DS. * p < 0.05 was statistically significant by Wilcoxon Signed Ranks test.

Outcomes	Pre quarantine	During quarantine	p-value
GSS (points)	38.6 ± 1.7	25 ± 1.7	p < 0.001*
Glycaemia (mg/dL)	142.1 ± 25.4	150.8 ± 29.4	p < 0.001*

Table 4 – Glycemia, number of steps and minutes of exercise pre and during the quarantine (n = 100). All values are shown mean ± DS. * p < 0.05 was statistically significant by Wilcoxon Signed Ranks test.

Outcomes	Pre-quarantine	During quarantine	p-value
Minutes of exercise	66 ± 42	38 ± 31	p < 0.001*
Glycaemia (mg/dL)	139.4 ± 22.0	147.8 ± 26.8	p < 0.001*
Steps number	12606 ± 5026	4760 ± 3145	p < 0.001*

overloaded and PWT1D have less possibilities to interact with clinicians with a possible repercussion on disease and therapy management.

An encouraging aspect that emerge from our data is that PWT1D tried to remain active in the quarantine period but, nevertheless their PA level was adequate, it seems that it was not sufficient to totally prevent glycemia rising. The main training methods used by PWT1D trough application or video in internet and an implementation of this "tele-exercise" provided by Sport Specialist could help patients to remain active in a totally safe way. Training is usually seen as a protective factor but, in this situation, it was almost halved and PWT1D, to control adverse glycemic events, had to modify therapy increasing both rapid both basal insulin deliveries. In particular, when lifestyle decrease from active to sedentary, clinicians suggest PWT1D to improve basal and bolus insulin delivery from 20 to 40% and to adequate doses after 2–4 days. Mean glycemia level increased according to PWT1D perceptions of increased glycemic variability. Rise of glycaemia and glycemic variability are indicators of poor glycemic control that usually restore in a long period. [23,24].

We are conscious of some limitations of this study. Primary, due to the impossibility to recruit people in the quarantine, people responded on a voluntary base to the survey. This caused a bias to the sample, in fact, the majority of responders were active people. However, this aspect, enforce the validity of the results because, also in a sample of trained people, we found alterations in glycemia trend and difficulties in therapy management. Furthermore, PA assessment could be affected by some bias due to self-reported questionnaires (wrong perception of actual PA) and accuracy of smartwatches. Nevertheless, the values of both self-reported and objectively measured PA data showed the same trend of reduction of exercise.

In conclusion, training level and performance are destined to decreased during the quarantine so it is conceivable that, also when usual training routine will be resumed, health benefits will be less substantial. For this reason, guidelines for PWT1D on exercise during quarantine should be established. In our opinion and in accordance with previous studies, to face the less possibilities to exercise, aerobic exercise of moderate to vigorous should be performed with an accurate control of heart rate and circuit or resistance training should be preferred to classical body weight exercise [24–27].

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