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Original Research Article

Health-Related Quality of Life in Adolescents during Quarantines Due to COVID-19 Pandemic: The Effect of Physical Activity and Gender

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Abstract

Given that deterioration of adolescents' health status during pandemic is well documented, health related quality of life (HRQoL) assessment is very important, as it contributes in adolescents' development and maturation into healthy adults. The main purpose of the study was to assess adolescents' HRQoL during the two strict lockdowns due to COVID-19. Secondary aims were to examine differences in HRQoL with regard to gender, and physical activity/sport participation before and during lockdowns. It was a cross-sectional study and conducted during first and second strict lockdowns. Three hundred and sixty-three adolescents (N=363) from secondary schools, in the Greek territory (108 boys and 255 girls) filled in the TNO-AZL Questionnaire for Children's Health-Related Quality of Life Children's Form, online, once. Also, demographic and anthropometric data were collected. For all TACQOL-CF subscales results showed that scores were lower, than the maximum subscales scores. Also, adolescents' responses to open questions supported further the low subscales scores. In addition, adolescents who participated in sport before lockdowns reported better scores in motor functioning/performance during lockdowns than their non-physically active peers ($p<0.05$). Moreover, girls reported significantly lower scores compared to boys in general physical functioning/complaints subscale ($p<0.05$). The findings of this study highlighted that during the two strict quarantines adolescents' HRQoL was deteriorated. Sport participation before the pandemic influenced positive HRQoL during quarantines and also quarantines affected differently adolescents by gender. Thus, the results should give information in adopting preventive strategies by policy makers to alleviate long-term negative consequences, in order adolescents to gain pre-pandemic HRQoL levels, in the transitional post-COVID-19 era.

Keywords: Health status, well-being, moods, pandemic, sport.

INTRODUCTION

Health-related quality of life (HRQoL) has been increasingly used as a multidimensional construct and a health outcome among children and adolescents. It incorporates the perception of physical, psychological, and social well-being at early ages, according to evolutionary development and individual differences, within a specific cultural context (Urzúa Morales *et al*., 2013; Kuyken, 1995). "Health related quality of life (HRQoL), has been defined as the level of well-being derived from the evaluation that a person makes in diverse domains of his life, considering the impact these have on his health status" (Urzúa Morales, 2010). High level of HRQoL is likely to lead in a child's normal development and maturation into a healthy adult (Riley *et al*., 2006). In the present study, the TNO-AZL Questionnaire for Children's Health-Related Quality of Life – Children's Form (TACQOL-CF) was used. HRQoL, as assessed by the TACQOL, is defined as children's (aged 6 to 15) health status, considering the emotional response of them to their health status problems. It has found to be a reliable instrument (Cronbach's α ranged from 0.65 to 0.84) and it was

validated to be used in general and in chronic conditions population (Flapper *et al*., 2013; Grootenhuis *et al*., 2007; Flapper *et al.*, 2006; Verrips *et al*., 1999). It was suggested that the method of the TACQOL administration may influence its results and their interpretation (Verrips *et al*., 2000).

As the corona virus disease 2019 (COVID-19) started to become a pandemic, in the spring of 2020, lockdowns in many world countries and two national strict lockdowns in the Greek territory were imposed with school closures, cancellation of team sports leagues games and practices, sport activities in organized environments, in order the spread of the virus to be slowed (Androutsos *et al*., 2021). These restrictions reduced the possibilities of children for being active and adopting a healthy lifestyle. Available data from countries all over the world including Greece showed a reduction in physical activity (PA) and sport participation, an increase in screen time and a transition to distance learning, in children and adolescents, during both strict lockdowns (Katartzi *et al*., 2022; Yelizarova *et al*., 2022; Alghadir *et al*., 2021; Chambonniere *et al*., 2021; Kovacs *et al*., 2021; Štveráková *et al*., 2021; Wunsch *et al*., 2021; Dunton *et al*., 2020; Moore *et al*., 2020; Schmidt *et al*., 2020; Seculic *et al*., 2020). It was confirmed that COVID-19 and quarantines affected, also, negatively HRQoL in children and adolescents (Nobari *et al*., 2021; Ng *et al*., 2020; Racine *et al*., 2020). Thus, it was reported a negative impact of the COVID-19 regulations on daily life, HRQoL and global health, in sleep habits, mental health, anxiety, mood, self-esteem, social relationships (Luijten *et al*., 2021; Mastorci *et al*., 2021; Ravens-Sieberer *et al*., 2021). On the contrary, although children reported generally good HRQoL, their parents stated that their children gained weight, were sleepy and overused internet, during the quarantine (Adıbelli & Sümen, 2020).

It is well known that sport and PA, play an important role in improving health in children and adolescents, providing better physical and mental health and psychosocial well-being, including a healthy immune system (Carson *et al*., 2017; Lasselin *et al*., 2016). It was found that adolescents who participated in organized sports reported higher academic achievement, greater levels of PA, decreased levels of anxiety and depression, and better HRQoL than their peers who did not participate in sports (Lam *et al*., 2013). Additionally, it was appeared that increased participation in PA was linked to better HRQoL, while increased time of sedentary behavior was associated with lower HRQoL, among children and adolescents (Shull *et al*., 2020; Wu *et al*., 2017; Eime *et al*., 2013). Furthermore, it was, also, well documented that PA engagement among adolescents during lockdowns was associated with increased mental health and well-being whereas, reduced PA participation associated with poorer psychosocial status (Katartzi *et al*., 2022; Morres *et al*., 2021; Wright *et al*., 2021). In addition, it was shown increased anxiety and depression symptoms and poor HRQoL in athletes during COVID-19 (McGuine *et al*., 2021). However, findings suggested that PA during the pandemic could counteract the negative effects of corona virus fear on adolescent mental health and well-being (Wright *et al*., 2021).

Gender differences should be taken into consideration when HRQoL and PA are examined in adolescents. It was stated that that females were less physically active (Bann *et al*., 2019) and reported higher levels of anxiety, depression, and stress than males (Sadler *et al*., 2018). In addition, in the context of quarantines, studies in PA participation examining gender differences had controversial results with some studies indicating higher PA participation in females (Moore *et al*., 2020; Schmidt *et al*., 2020; Sekulic *et al*., 2020) and others higher in male adolescents (Ng *et al*., 2021; Yelizarova *et al*., 2022). Additionally, for HRQoL during the pandemic and quarantines, it was suggested that corona virus fear, perceived stress, and anxiety was found to be significantly higher in females (Ng *et al*., 2021; Wright *et al*., 2021; Schmidt *et al*., 2020) and also female athletes reported higher anxiety symptoms (McGuine *et al*., 2021). Furthermore, COVID-19 pandemic affected negatively the dimensions of HRQoL according to gender, with girls showing lower scores than boys in most of the studies (Ahn, 2022; Mastorci *et al*., 2021; Morres *et al*., 2021; Nobari *et al*., 2021). Additionally, positive relationships between HRQoL scores, before the pandemic and PA participation during lockdown, were indicated in female children and adolescents (Wunsch *et al*., 2021).

It is therefore unclear how the two strict quarantines have impacted HRQoL among adolescents, in Greece. It is also important to be assessed how sport and PA participation during and pre lockdowns affected HRQoL during the two strict quarantines. These results could give valuable information for effective measures to be taken, in order the probable negative consequences, of quarantines to be prevented in the post COVID-19 era. In the present study, it was anticipated that the two strict lockdowns had a negative impact in HRQoL, in adolescents. It was firstly hypothesized that adolescents indicated lower scores in the dimensions of HRQoL during strict lockdowns. A second hypothesis was that adolescents would be differentiated in HRQoL with regard to their physical activity/sport participation during and before lockdowns. Finally, a third hypothesis was that adolescents would be differentiated in HRQoL, according to their gender. As a result, the main purpose of the study was to assess adolescents' HRQoL during the two strict lockdowns due to COVID-19. Secondary aims were to examine differences in HRQoL with regard to gender, and physical activity/sport participation before and during lockdowns.

MATERIAL & METHODS

Participants and Study Design

It was a cross-sectional study that was approved by the Departmental Research Ethics Committee and data were collected from adolescents who filled in online questionnaires once, from April to June 2020 and November 2020 to January 2021, during the strict quarantines, when lessons at schools were online and all sport activities had been cancelled. Adolescents' parents signed informed consents after they had informed about the research requirements and procedures. Adolescents' names and any identifying information were not collected and their participation was voluntary. In Greece, there were approximately 312604 secondary school students spread over 13 regions in Greek territory (Hellenic Statistical Authority, 2019). Statistical calculators based on a reference technique for sample size was used (Qualtrics Experience Management, 2021), and in a population of 312604, a sample of 384 participants was considered representative at the 95% confidence level, with a standard margin of error of 5%. Although, the questionnaire was sent to 384 adolescent students, as it was planned to randomly recruit them, finally 363 adolescents participated in the study. 108 boys (Mean age: 14.48±1.49 years, Mean body weight: 63.37±13.91 Kg, Mean body height: 171.42±10.45 cm) and 255 girls (Mean age: 14.74±1.73, Mean body weight: 57.06±9.49, Mean body height: 165.44±7.17). For all depended variables examined in the present study, data from both quarantines analyzed together due to non-significant differences ($p>0.05$), (Table 1).

Table 1: Demographic and anthropometric data of adolescents (*N*=363)

Anthropometrics	
	Mean ± sd
Age (ys)	14.66 ± 1.67
Body Height (cm)	167.07 ± 9.27
Body Weight (kg)	58.94 ± 11.35
Demographics	
Covid-19 lockdowns	1st =203, 2nd = 160
Gender	boys =108 girls = 255
Sport participation pre-COVID-19	YES =313, NO = 50
PA participation during lockdowns	YES =250, NO = 113
Residence	city=242, country =121
Place of residence	house =192, apartment = 171

Procedure and Study Instruments

For the main purpose of the study the TNO-AZL Questionnaire for Children's Health-Related Quality of Life (HRQoL)-children form (TACQOL-CF), a multidimensional instrument with 7 scales and 56 items was used (Vogels *et al*., 1998). It was consisted of seven eight-item domains: problems/limitations concerning, general physical functioning/complaints (BODY), motor functioning/performance (MOTOR), independent daily functioning (AUTO), cognitive functioning and school performance (COGNIT), social contacts with parents and peers (SOCIAL), positive moods (EMOPOS) and negative moods (EMONEG), during lockdowns. The prevalence of problems in health status was measured, in each item. When a health status problem was reported, the adolescent completed his/her emotional reaction to this problem referred to a period of 'the last few weeks'. An example of an item for BODY was "Have you had headaches?" with responses in a scale from 'never', 'occasionally' to 'often'. When the response was 'occasionally' or 'often', another statement should be answered 'at that time, I felt…', in a scale from 'fine', 'not so good', 'quite bad' to 'bad'. Items were scored taking a value from 4 to 0. A total scale score had a range of 0 to 32, which was resulted by adding item scores within a scale. Higher scale scores indicated better HRQoL. Different responses were given in positive or negative mood scales (EMOPOS & EMONEG). A typical mood item was 'In the past few weeks I felt happy', with responses in a scale from 'never', 'occasionally' to 'often'. Mood item were scored taking a value from 0 to 2. Total mood scale score ranged from 0 to 16. No total score of health status was calculated, only single scale's scores. In the present study, the questions in each scale were summed and the higher total scores of scales indicated better functional status. Internal consistency (*Cronbach's α*) in scales' scores for the Greek version, ranged from 0.65 to 0.84. Test retest reliability was within acceptable values for all scales (*ICC*>0.74). Moreover, there were, also, open questions for each one of the subscales. For BODY "What type of symptoms?" and "What do you think caused that pain or those symptoms?", for MOTO, AUTO, COGNIT and SOCIAL "What do you think caused those problems?" and for EMOPOS and EMONEG "What was the reason for that?". Also, regarding participation in sport/physical activity, "yes or no" questions as "Did you participate in organized sports before the outbreak of COVID-19" and "Are you participating in any kind of PA now/during lockdown". Organized sport participation was considered to be any kind of participation in structured sport clubs. Moreover, "participation in any kind of PA during lockdowns" was considered to be any kind of participation in PA e.g. online physical education classes, online sport training and outdoor physical activities that were allowed e.g. walking, jogging etc. An

online Google form questionnaire which was consisted of three parts, were used. The first part included information about the purpose and importance of the study, instructions, and parents' informed consent, adolescent's agreement for participation and anthropometric and demographic details. The second part included the TACQOL with the seven subscales, measuring current health functional status during the period of lockdown. In the last part, there was available contact information.

Statistical analysis

Descriptive statistics were performed for better representation of the averages through data tables. Internal consistency analysis was assessed using Cronbach's alpha in all TACQOL-CF subscales. A multivariate analysis of variance was conducted by gender on general physical functioning/complaints, motor functioning/performance, independent daily functioning, cognitive functioning and school performance, social contacts with parents and peers, positive and negative moods scores. Univariate ANOVA's were also conducted. To assess the strength of the results, partial-eta-squared (η^2=0.01 small, η^2=0.06 medium and η^2=0.14 large), (Field, 2010) and Cohen's ***d*** values were calculated (Sawilowsky, 2009; Cohen, 1988). Statistical significance was set at $p<0.05$ level.

RESULTS

TACQOL-CF subscale scores reported during lockdowns in adolescents

Internal consistency analysis using Cronbach's alpha in all TACQOL-CF subscales showed values which ranged from α=0.72 to α=0.90. Results showed that scores in general physical functioning/complaints (BODY), motor functioning/performance (MOTOR), independent daily functioning (AUTO), cognitive functioning and school performance (COGNIT), social contacts with parents and peers (SOCIAL) positive (EMOPOS) and negative moods (EMONEG), reported during lockdowns in adolescents were lower, than the maximum subscales scores (Figure 1). Moreover, regarding open questions, adolescents answers are depicted in Table 2.

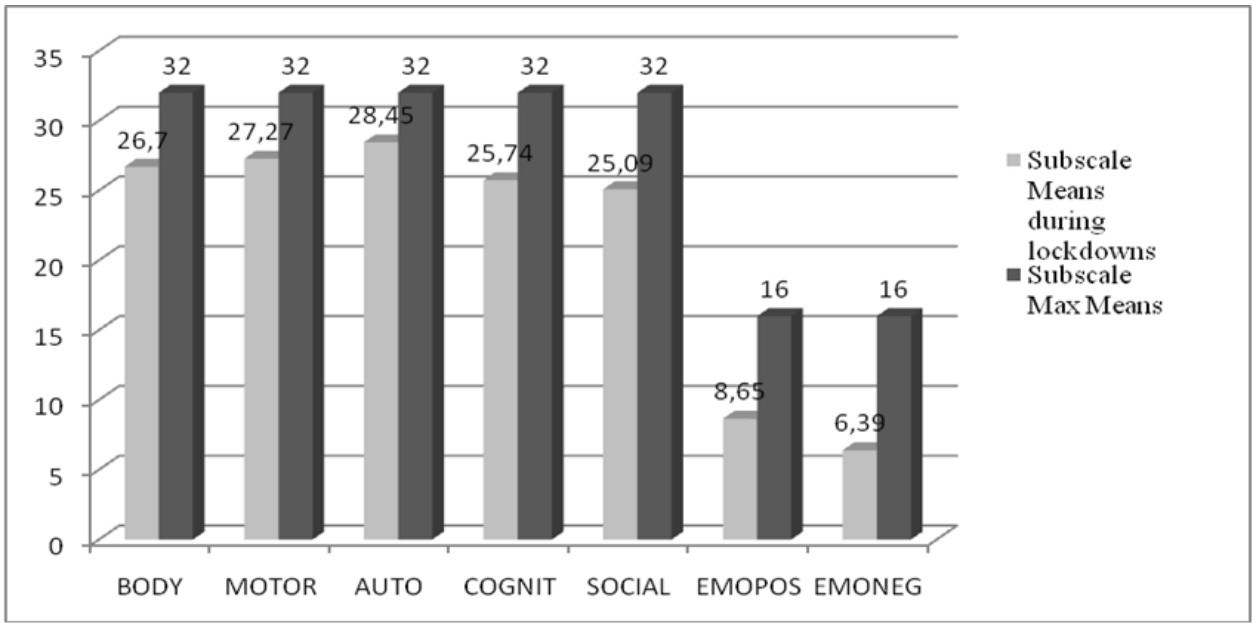

Figure 1: TACQOL-CF subscale scores reported during lockdowns in adolescents

Table 2: Adolescents responses to TACQOL-CF subscale open questions

TACQOL subscales	Open Questions	Adolescents' responses
BODY	What type of symptoms?	Musculoskeletal pain, headaches, dizziness, stomachaches, sleepiness, boredom, fatigue, weakness
	What do you think caused that pain or those symptoms?	Lack of exercise, sedentary life, overuse of computer or mobile phones, fatigue, pressure of lockdown measures, wrong body posture, going to bed late-eating, overeating, anxiety
MOTOR	What do you think caused those problems?	Lack of exercise and participation in school PA, sport and playing activities, sedentary life, not being fit, lockdown, body weight gain, negative psychological state, boredom
AUTO		Restrictive measures, fear of virus infection, lack of adequate physical activity, body weight gain, negative psychological state

TACQOL subscales	Open Questions	Adolescents' responses
COGNIT		Distance learning- overuse of a computer/or mobile phone, lack of understanding lessons, lack of internet connection, lack of directivity with teachers, distancing from regular school program and setting, lack of interest, sleepiness, going to bed late, anxiety, fatigue, lockdown
SOCIAL		Pressure by restrictive measures/lockdown, distance communication with friends/grandparents/relatives-getting used to social isolation, long hour coexistence with parents and siblings caused arguments without reason, being nervous/angry, boredom, negative psychological state isolated them from friends, this new global situation, fear of virus infection, overprotective parents
EMOPOS-EMONEG	What was the reason for that?	Restrictive measures and lockdown, boredom, fear of infection, uncertainty about world's future, distance from friends/grandparents/relatives, computer games, fear caused by the TV news, pressure of project deadlines in lessons-anxiety, lack of freedom and change in regular everyday life – not going to school and out of school activities, social isolation, overprotective parents, lack of qualitative time in their lives

Differences in TACQOL-CF subscales scores according to during lockdowns physical activity participation and gender

Firstly, a two-way multivariate analysis of variance (MANOVA) was conducted using adolescents' during lockdowns physical activity participation (PA) and gender as independent variables (PA*2 and gender*2) on the seven TACQOL-CF subscales. A non significant during lockdowns physical activity by gender (PA *2 by gender*2) multivariate interaction effect was revealed [*Wilk's lambda* = 0.995, $F_{(7, 353)}$ = 0.276, P = 0.963, η^2 = 0.005]. Follow-up two-way analysis of variance (ANOVA) revealed no significant interaction effects for the seven TACQOL-CF subscales. Subsequently, main effects were examined for during lockdowns physical activity participation and gender, separately. There was not a significant multivariate main effect for during lockdowns physical activity participation [*Wilk's lambda* = 0.983, $F_{(3,359)}$=0.851, P = 0.546, η^2 =0.017]. Adolescents who participated in physical activity compared to non-physical active peers during lockdowns reported no significant differences in all TACQOL-CF subscale scores (Table 3).

Secondly, a one-way multivariate analysis of variance (MANOVA) was conducted to examine the effects of gender (gender*2) on seven TACQOL-CF subscales scores. For gender, there was a significant multivariate main effect [*Wilk's lambda* = 0.949, $F_{(3,353)}$ = 2.68, P = 0.010, η^2 = 0.051]. Significant univariate effects emerged only for BODY [$F_{(1,362)}$ = 9.03, P = .003, η^2 = 0.025]. For TACQOL-CF subscales girls reported significantly lower mean scores compared to boys in BODY (Table 3).

Table 3: Means, standard deviations, two-way MANOVA (during lockdowns PA participation *gender) for the TACQOL-CF subscales

TACQOL-CF subscales	during lockdown PA/S participation (N=250)			during lockdown PA/S non participation (N=113)			Gender		PA/S main effect df=1			Gender main effect df=1			Interaction effect (PA/S *gender) df=359		
	Male (N=74)	*Female (N=176)*	*Total*	*Male (N=34)*	*Female (N=79)*	*Total*	*Male (N=108)*	*Female (N=255)*	***F***	***P***	η^2	***F***	***P***	η^2	***F***	***P***	η^2
	M±SD	*M±SD*	*M±SD*	*M±SD*	*M±SD*	*M±SD*	*M±SD*	*M±SD*									
BODY	25.50±6.05	22.68±5.77	23.51±5.98	24.08±5.72	22.36±6.95	22.88±6.62	25.05 ±5.96	22.58±6.15	1.30	0.254	0.004	9.03	0.003*	0.025	0.528	0.468	0.001

MOTOR	28.33±4.44	27.09±4.78	27.46±4.71	27.08±6.50	26.77±5.86	26.86±6.03	27.94±5.18	26.99±5.13	1.513	0.219	0.004	1.503	0.221	0.004	0.533	0.466	0.001
AUTO	28.47±4.52	28.27±4.65	28.33±4.61	28.05±5.36	29.00±4.57	28.71±4.82	28.34±4.78	28.50±4.63	0.070	0.791	0.000	0.415	0.520	0.001	0.959	0.328	0.003
COGNIT	26.54±5.32	25.72±5.23	25.96±5.26	25.82±5.67	25.01±6.47	25.25±6.23	26.31±5.42	25.50±5.64	1.064	0.303	0.003	1.391	0.239	0.004	0.000	0.995	0.000
SOCIAL	25.17±3.93	25.19±4.17	25.13±4.09	24.58±4.74	25.20±4.68	25.01±4.69	24.99±4.19	25.14±4.33	0.224	0.636	0.001	0.275	0.600	0.001	0.397	0.529	0.001
EMOPOS	8.60±1.77	8.80±1.94	8.74±1.89	8.41±2.31	8.48±1.63	8.46±1.85	8.54±1.94	8.70±1.85	1.253	0.264	0.003	0.330	0.566	0.001	0.077	0.782	0.000
EMONEG	6.51±2.14	6.32±1.97	6.38±2.02	6.52±2.33	6.35±2.03	6.40±2.11	6.51±2.19	6.33±1.98	0.006	0.936	0.000	0.497	0.481	0.001	0.000	0.986	0.000

Note: Statistically significant findings (, p < 0.05). An asterisk (*) denotes a statistical significance*

Differences in TACQOL-CF subscale scores according to pre-lockdowns sport participation and gender

Firstly, a two-way multivariate analysis of variance (MANOVA) was conducted using adolescents' pre-lockdowns sport participation and gender as independent variables (S*2 by gender*2), on the seven TACQOL-CF subscales. A non significant pre-lockdowns sport participation by gender multivariate interaction effect was revealed [*Wilk's lambda* = 0.980, $F_{(7, 353)}$ = 1.042, *P* = 0.401, η^2 = 0.020]. Follow-up two-way ANOVAs revealed no significant interaction effects for the seven TACQOL-CF subscales. Subsequently, main effects were examined for pre-lockdowns sport participation and gender, separately. There was not a significant multivariate main effect for gender [*Wilk's lambda* = 0.982, $F_{(7, 353)}$ = 0.922, *P* = 0.489, η^2 = 0.018]. For all TACQOL-CF subscale scores adolescents reported no significant differences in mean scores according to gender. Secondly, a one-way multivariate analysis of variance (MANOVA) was used to examine the effects of pre-lockdowns sport participation (S*2) on scores of TACQOL-CF. For pre-lockdowns sport participation, there was a significant multivariate main effect [*Wilk's lambda* = 0.954, $F_{(3,359)}$ = 2.406, *P*= 0.020, η^2 = 0.046]. Significant univariate effects emerged only for MOTOR [$F_{(1, 359)}$ = 4.27, *P*= 0.04, η^2 = 0.012]. Adolescents who participated in sport before lockdowns reported better motor functioning/performance during lockdowns than their non-physically active peers (Table 4).

Cohen's d effect sizes (*ES*) for each one of the TACQOL-CF subscales, gender, during and pre-lockdowns physical activity/sport participation group comparisons are presented in Table 5. A *d* value of 0.01 denotes a very small *ES*, a 0.20 denotes a small *ES*, a value of 0.50 a medium *ES*, a value of 0.80 a large *ES*, a value of 1.20 a very large and a value of 2.0 a high *ES* (Cohen, 1988; Sawilowsky, 2009). Regarding gender, except BODY with a small to medium *ES* (*d* = 0.40), the remaining subscales corresponded to a small up to a very small *ES* (values ranging from 0.03 to 0.18). In addition, regarding physical activity/sport participation during and pre-lockdowns, all TACQOL-CF subscales corresponded to a small up to a very small *ES* (values ranging from 0.009 to 0.15) and (values ranging from 0.02 to 0.23), respectively (Table 5).

Table 4: Means, standard deviations, two-way MANOVA (pre-lockdowns sport participation *gender) for the TACQOL-CF subscales

TACQOL-CF subscales																				
Pre- lockdown PA/S participation *(N=313)*				**Pre- lockdown PA/S non participation *(N=50)***			**Gender**		**PA/S main effect df=1**			**Gender main effect df=1**			**Interaction effect (PA/S *gender) df=359**		
	Male (N=97)	*Female (N=216)*	*Total*	*Male (N=11)*	*Female (N=39)*	*Total*	*Male (N=108)*	*Female (N=255)*	***F***	***P***	η^2	***F***	***P***	η^2	***F***	***P***	η^2
	M±SD	*M±SD*	*M±SD*	*M±SD*	*M±SD*	*M±SD*	*M±SD*	*M±SD*									
BODY	25.36±5.96	22.66±5.89	23.49±6.04	22.36±5.46	22.15±7.47	22.20±7.03	25.05±5.96	22.58±6.15	2.519	0.113	0.007	1.734	0.189	0.005	1.27	0.261	0.004
MOTOR	28.27±5.04	27.07±5.02	27.45±5.05	25.00±5.74	26.51±5.73	26.18±5.71	27.94±5.18	26.99±5.13	4.27	0.040*	0.012	0.028	0.866	0.000	2.126	0.146	0.006
AUTO	28.40±4.87	28.37±4.70	28.38±4.74	27.81±4.04	29.17±4.25	28.88±4.20	28.34±4.78	28.50±4.63	0.016	0.899	0.000	0.621	0.431	0.002	0.663	0.416	0.002
COGNIT	26.37±5.57	25.59±5.45	25.83±5.49	25.81±3.99	25.00±6.62	25.18±6.12	26.31±5.42	25.50±5.64	0.319	0.572	0.001	0.620	0.431	0.002	0.000	0.984	0.000
SOCIAL	24.79±4.15	25.07±4.25	24.99±4.21	26.72±4.31	25.51±4.77	25.78±4.66	24.99±4.19	25.14±4.33	2.318	0.129	0.006	0.357	0.550	0.001	0.930	0.336	0.003
EMOPOS	8.56±1.95	8.70±1.89	8.66±1.90	8.36±1.96	8.69±1.67	8.62±1.72	8.54±1.94	8.70±1.85	0.103	0.749	0.000	0.471	0.493	0.001	0.075	0.785	0.000
EMONEG	6.50±2.21	6.36±1.97	6.40±2.05	6.63±2.06	6.17±2.08	6.28±2.07	6.51±2.19	6.33±1.98	0.005	0.941	0.000	0.639	0.425	0.002	0.181	0.671	0.001

Note: Statistically significant findings (, p < 0.05). An asterisk (*) denotes a statistical significance*

Table 5: *Cohen's d* effect sizes *(ES)* for each one of the TACQOL-CF subscales for gender and during and pre-lockdowns physical activity/sport participation group comparisons.

TACQOL-CF subscales	*Cohen's d*		
	Gender	**during lockdowns PA participation**	**pre-lockdowns sport participation**
BODY	0.40	0.09	0.19
MOTOR	0.18	0.11	0.23
AUTO	0.03	0.08	0.11
COGNIT	0.14	0.12	0.11
SOCIAL	0.03	0.02	0.17
EMOPOS	0.08	0.15	0.02
EMONEG	0.08	0.009	0.05

DISCUSSION

The main purpose of the study was to assess adolescents' HRQoL during the two strict lockdowns due to COVID-19. Secondary aims were to examine differences in HRQoL with regard to gender, and physical activity/sport participation before and during lockdowns.

According to the first hypothesis the results showed that scores in general physical functioning/complaints, motor functioning/performance, independent daily functioning, cognitive functioning and school performance, social contacts with parents and peers positive and negative moods, reported during lockdowns in all adolescents were lower, than the maximum subscales scores. Additionally, regarding body pain the majority of complaints included musculoskeletal pain, headaches, dizziness, stomachaches, sleepiness, fatigue and weakness. Pressure of lockdown measures, lack of exercise, sedentary life, distance learning and overuse of computer or mobile phones were common causes of adolescents' poor HRQoL, in all dimensions. Moreover, based on subscales separately, adolescents reported that among the causes that affected negatively their psychological health status were, body weight gain, boredom, fear of virus infection and by the TV news, lack of interest, sleepiness/anxiety, being nervous/angry, negative psychological state, uncertainty about world's future, overprotective parents, social isolation, arguments with parents and siblings due to long coexistence, lack of freedom and change in regular everyday life, lack of qualitative time in their lives. Lack of understanding lessons, of directivity with teachers, and of home internet service were among the common reasons for negative cognitive functioning and school performance. Results are in agreement with those from previous studies which found that adolescents reported poorer HRQoL with similar physical and mental status such as anxiety symptoms, poor mood states and self-esteem status, social relationships, unhealthy sleep habits and global health (Luijten *et al*., 2021; Mastorci *et al*., 2021; Ravens-Sieberer *et al*., 2021). Comparing the results of the present study with studies used TACQOL-CF, it was obvious that scores in all dimensions were similar with those reported by children with chronic conditions (Grootenhuis *et al*., 2007), proving that pandemic and quarantines affected negatively adolescents' health status, with very poor scores in positive and negative moods.

According to the second hypothesis adolescents who participated in any kind of PA during lockdowns reported no differences in their health status compared to their peers who didn't participate in PA during lockdowns. Moreover, the results showed that adolescents who participated in organized sports before lockdowns reported higher scores only in motor functioning/performance subscale, during lockdowns compared to their peers who didn't participate in sports, before lockdowns. These results indicated that adolescents' participation in sport before the pandemic may have affected motor functioning positively during quarantines, which is an important dimension of HRQoL given that adolescents' participation in high levels of PA lead in an increased HRQoL (Marker *et al*., 2018; Wu *et al*., 2017). However, scores in HRQoL for both adolescent athletes and non athletes, in the present study, were low during lockdowns and this finding is in accordance with a study which indicated worse mental health, physical activity participation and HRQoL scores during COVID-19, than were previously noted (McGuine *et al*., 2021). However, although previous studies indicated positive relationships between adolescents' participation in PA during lockdowns, mental health and well-being with athletes scoring higher than non athletes in well-being and positive energy (Katartzi *et al*., 2022; Morres *et al*., 2021; Wright *et al*., 2021), whereas reduced participation in moderate to vigorous PA, had a negative impact in mood states (Chang *et al*., 2020; Zhang *et al*., 2020), the findings of the present study were not in line with them. These may be due to the decreased levels of PA in adolescents, during both strict quarantines which were insufficient to affect positively HRQoL (Katartzi *et al*., 2022). However, although findings suggest that PA during the pandemic can counteract the negative effects of corona virus fear on adolescent mental health and well-being (Wright *et al*., 2021) PA should be according to official recommendations, in order to have physical and psychological benefits (WHO, 2020).

According to the third hypothesis the results showed that girls indicated lower scores only in general

physical functioning/complaints compared to boys. Thus, girls stated more body pain and complaints about their health status. Studies in adolescents conducted during the pandemic showed similar results. Thus, girls indicated poorer HRQoL compared to boys (Ahn, 2022; Nobari *et al*., 2021). All that, females scored lower in mood-emotion and self-perception dimension, while males had better physical well-being, but lower PA scores regarding life-style assessment (Mastorci *et al*., 2021). In addition, female adolescents, in a Greek study, were found to have worse scores in well-being and positive moods, but better scores in negative moods compared to males and lower in physical activity (Morres *et al*., 2021). Moreover, female young athletes of team sports from low income areas reported higher anxiety symptoms, depression, lower levels of physical activity, and lower HRQoL, in May 2020 (McGuine *et al*., 2021). In conclusion, it was seemed that the pandemic affected differently gender and therefore, future studies should consider gender issues in adolescents.

To sum up, in the present study, HRQoL was decreased dramatically during both strict lockdowns in Greek adolescents. Among the factors that may have impacted negatively these findings were decreased PA and sport participation, sedentary life and use of devices, social isolation and future uncertainty. Also, differences in gender regarding HRQoL in the dimension of perception of physical pain may, also, be considered. However, social isolation and restrictive measures imposed by governments impacted various health habits, decreased PA participation and increased sedentary time and overuse of electronic devices (computers, or mobile phones) with negative consequences on adolescents' mental health and HRQoL (Katartzi *et al*., 2022; Androutsos *et al*., 2021; Morres *et al*., 2021; Wright *et al*., 2021; Wunsch *et al*., 2021; Schmidt *et al*., 2020). It was also documented that the absence of social interaction can affect the feeling of vitality and the perception of general health which have a direct impact on mental health. All these reactions can influence harmfully physical aspects, decreasing functionality and increasing the perception of physical pain (Li *et al*., 2020). In conclusion, adolescents' HRQoL seemed to have been damaged during the isolation period of the pandemic with PA/sport participation and gender playing an important role.

Overall, studies on the impact of lockdowns in adolescents' HRQoL indicated different results which are comparable in many cases, although there were different methodologies e.g. different questionnaires, the time period when the studies were conducted, countries' different policy measures in promoting PA, differentiated restrictions imposed by governments and also, the number of the virus infections among countries that directly affected public behavior. For the case of Greece, authorities published instructions to urge people stay physically active, during self-quarantine (EuroWHO, 2020; WHO, 2020), although restrictive measures were very strict during both lockdowns (Androutsos *et al*., 2021). As a result, this social isolation policy, limited opportunities in adolescents for participation in PA and this coupled with sedentary behavior due to distance learning and using streaming services for every day communication, may have deteriorated HRQoL. Although there were virtual options for students' participation PA/sport during quarantines, it was reported that may have been insufficient.

Given that the deterioration of adolescents' HRQoL due to pandemic is well documented, the strength of this study was that adds data for this sensitive age group, in which HRQoL assessement is very important for a typical development and maturation into a healthy adult (Riley *et al*., 2006). In addition, the influence of PA/sport participation and gender were also examined adding more information, as they were considered important factors in previous studies. The assessment was conducted by online self-reported questionnaires all over the Greek territory, during first and second strict lockdowns. A limitation of the present study was that HRQoL was measured by online self-reported questionnaires, and their reliability should be questioned (Verrips *et al*., 2000). Results cannot possibly be generalized in other countries. Future studies should assess the long-term consequences of the pandemic regarding HRQoL in adolescents and if targeting sports and exercise opportunities may improve them, taking in consideration gender, too. In this way, such information will help to provide an evidence-base for public policy in order to invest in health promotion through PA programs, in school physical education settings and in extra-curricular sport activities. The main aim of this public policy should be the enhancement of HRQoL among adolescents in the post pandemic era and also in possible future restrictive situations.

CONCLUSIONS

The findings of this study highlighted that during the two strict quarantines in Greece, adolescents' HRQoL was deteriorated, stressing the importance of this assessment for public policy makers, in order to adopt preventive strategies to alleviate long-term negative consequences. Sport participation before the pandemic influenced positive motor functioning and performance dimension of HRQoL during quarantines and also regarding gender differences and HRQoL dimensions, evidence was shown that quarantines affected differently adolescent boys and girls. Thus, further research is encouraged aiming at promoting effective interventions which should incorporate PA programs, in order adolescents to gain pre-pandemic HRQoL levels, in the transitional post- COVID-19 era.

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