HEALTH PROMOTION

Trends in Adolescent Mental Wellbeing in an Italian sample from 2004 to 2022 (HBSC Study): Gender, Age, and Socioeconomic Difference

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Keywords

Adolescence • Mental health • Mental wellbeing • Socioeconomic status • HBSC

Summary

Introduction. *There is an increasing discussion about the decline in adolescent mental well-being over time, but existing literature provides limited data on this trend.*
The aim of our study is to examine how the mental health of Tuscan adolescents aged 11-13 and 15 years may have changed over the years. Additionally, we seek to investigate the influence of factors such as gender, age, and socioeconomic status on these changes.
Method. *We analyzed data representative of the Tuscan region, collected from 18,439 adolescents through six rounds of the Health Behaviour in School-aged Children (HBSC) surveys conducted in 2004, 2006, 2010, 2014, 2018, and 2022. Hierarchical regression models were used to assess regional trends in adolescents' mental well-being, considering life satisfaction, psychological and somatic symptoms, and to evaluate how age, gender, and socioeconomic status might moderate these trends.*
Results. *In all survey years (except 2004), girls consistently reported higher levels of psychological and somatic complaints and lower life satisfaction compared to boys. Trend analysis from 2004 to 2022 showed a steady decline in all measured areas: life satisfaction, psychological complaints, and somatic complaints. Generally, older adolescents reported lower life satisfaction and higher levels of psychological and somatic symptoms.*
Conclusion. *Our findings indicate that the gender gap in mental well-being appears to be widening over time, whereas differences related to age and socioeconomic status have remained relatively stable. It is therefore crucial to pay increased attention, especially considering the potential impacts of the COVID-19 pandemic on adolescent mental health.*

Introduction

Adolescence is a unique developmental phase that marks the transition from childhood to adulthood. It is characterized by significant changes not only in physical development but also in psychological, relational, and social aspects. In recent years, there has been an increased focus on understanding the factors, particularly social ones, that influence health outcomes and contribute to health inequalities within populations [1]. Adolescent mental well-being is considered a public health priority at both the global and national levels [2], as more than half of adult mental health issues emerge during childhood and adolescence [3]. Previous research study has defined adolescent mental health as a multifaceted concept, including both mental health problems and subjective well-being [3].
In recent years, adolescents report lower levels of well-being and more mental health problems compared to their peers from one or two decades ago [4].
Evidence suggests a decline in the mental well-being of children and adolescents in developed countries, particularly among older girls [2, 4]. Numerous studies have identified increasing trends in mental health issues, especially internalizing problems, among adolescents across various countries over time [5, 6]. Several factors contribute to this increase. Lifestyle and health-related elements, including sleep patterns, physical activity, and sedentary behavior, play a significant role. School-related stress and the pervasive influence of the digital age also have an impact. Additionally, inter-parental conflict, social adversity, and the complex, bidirectional relationship between mental health and activity levels are recognized as important contributors [7].
Studies have consistently reported gender, age, and socioeconomic differences in the trends of adolescents' mental well-being [2, 4]. Analyses of temporal trends indicate that, in comparison to boys, girls are increasingly likely to report emotional problems [5], internalizing problems [4], lower life satisfaction, and more multiple health complaints [2]. Additionally, a notable decline in mental well-being has been observed from the onset to the conclusion of adolescence across several cohorts [2]. This decline in well-being, along with rising internalizing problems over time, is particularly pronounced among older adolescent girls [4]. Self-assessments of health

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among adolescents have shown a steady deterioration with age, with girls experiencing a more significant decline than boys [2, 6]. Socioeconomic inequalities play a significant role in influencing adolescents' mental health [8]. Adolescents from socially disadvantaged backgrounds report higher rates of poor subjective health, lower life satisfaction, and a greater burden of multiple health symptoms compared to their peers from more affluent families [8]. These individuals also experience reduced quality of life and well-being [9]. Previous literature indicates that social inequalities in adolescent mental health have intensified over time [9].

According to a recent UNICEF estimate, based on a Global Burden of Disease study, about 16.1% of Italian adolescents (age range 10-18) had a mental health disorder (17.2% girls and 16.6% boys) in 2019 which was below the European average (16.3%) [10]. In recent years, certain risky behaviors among Italian adolescents, such as alcohol use, smoking, binge drinking, and a sedentary lifestyle, have remained stable or slightly decreasing but continue to be prevalent and concerning according to the most recent data. Specifically, 17% of Italian 15-year-olds reported binge drunk at least once in the previous month; 14% of 15-year-old boys and 20% of 15-year-old girls have smoked at least one cigarette in their lifetime; 21% of 13- and 15-year-olds do not engage in sufficient physical activity. [11]. Additionally, there has been a steady increase in the number of children and adolescents receiving psychiatric care. According to the Ministry of Health, over 100,000 minors were under the care of child neuropsychiatry services in 2021. The international HBSC (Health Behaviour in School-aged Children) Report 2022 on adolescents across Europe shows that Italians are below the European average in terms of their mental well-being, particularly girls [12].

As such, it is important to provide an overview of the situation at the baseline before these policies are implemented.

Between 2004 and 2022, the mental well-being of Italian adolescents progressively worsened, as reflected by a decline in life satisfaction – from an average of 7.4 in 2004 to 7.0 in 2022 among 11 – to 15-year-olds. This period also saw an increase in psychological symptoms such as irritability, nervousness, and difficulty sleeping, as well as a rise in somatic complaints including headaches, stomachaches, and dizziness. While these trends were observed in the Tuscan sample of the HBSC study, they also mirror patterns identified at the national level [13]. This survey analyzes changes in adolescents' mental well-being, measured through life satisfaction, psychological symptoms, and somatic symptoms, and evaluates whether gender, age, and socio-economic gaps in these trends have increased in the Tuscany Region between 2004 and 2022 through data from the six HBSC surveys carried out in Tuscany.

Material and Methods

HBSC international survey collects data every four years on health behaviors, social environments, and sociodemographic characteristics in adolescents aged 11 to 15 using a standardized research protocol [13, 14]. The Italian HBSC survey is organized under the base of the "Surveillance system for risk behaviours in 11-15-year-olds". Data collection involved the recruitment of a two-stage stratified sample of classes and grade levels that represent the economic, and public-private distribution of schools in Italy [13, 14].

Classes were the primary sampling unit and 88.7% (5,669) of the total sampled classes (6,388) consented to participate. Adolescents completed anonymous questionnaires in classroom setting. This study included 18,439 students (97.3% of response rate at the individual level) aged 11, 13 and 15 years old from six Tuscany HBSC surveys (2004, 2006, 2010, 2014, 2018 and 2022). Regionally representative samples of 11, 13 and 15-year-olds were included in each wave: 2004 (N = 3,614; 49.5% girls), 2006 (N = 3,405; 51.2% girls), 2010 (N = 3,291; 48.3% girls), 2014 (N = 2,511; 52.4% girls), 2018 (N = 3,087; 49.8% girls) and 2022 (N = 2,531; 48.0% girls), respectively (Tab. I). Before data collection, students' parents received an information note describing the survey's purpose. Families could deny participation by filling in and returning the note to the teachers in each class involved. The study was conducted according to the guidelines of the Declaration of Helsinki.

The participants were assured of the anonymity and confidentiality of their responses. In 2022, the Italian HBSC study protocol and questionnaire were formally approved by the Ethics Committee of the Italian National Institute of Health (Ref. PROT- PRE876/17, 20 November 2017). Ethical approvals have been granted for the previous surveys as well.

Instruments

Psychological and Somatic Symptoms

The HBSC Symptom Checklist is a non-clinical tool used to assess two types of health symptoms: psychological symptoms (such as feeling down, irritability, nervousness, and sleep problems) and somatic symptoms (like headaches, stomach aches, back pain, and dizziness). Participants were asked to report how often they experienced these symptoms over the past six months. Response options included: "about every day," "more than once a week," "about every week," "about every month," and "rarely or never." This instrument has proven to be reliable and valid. In our sample, both subscales showed acceptable reliability, with Cronbach's alpha values of 0.70 for psychological symptoms and 0.77 for somatic symptoms. The items were scored in reverse where necessary. For each subscale, a mean score from 0 to 4 was calculated, with higher scores indicating more frequent symptoms.

Life Satisfaction

Life satisfaction was measured using the Cantril ladder,

where participants rated their happiness with life on a scale from 0 (worst possible life) to 10 (best possible life). For this study, the scale was treated as a continuous variable.

Gender and Age

Participants were asked to specify whether they are a boy or a girl and to provide their date of birth (month and year).

Socioeconomic Status

Socioeconomic status was assessed using the Family Affluence Scale (FAS), a 4-item measure developed by the HBSC network. FAS gauges material wealth within the family by asking about possessions like the number of cars and computers, whether they have their own bedroom, and how many family holidays they took in the past year. The scores are summed, ranging from 0 (lowest affluence) to 9 (highest affluence), and this score was used in further analyses.

Statistical Analysis

To assess how mental wellbeing indicators have changed from 2004 to 2022, we calculated the average scores for each survey year, both for the entire sample and separately for boys and girls. To analyze trends in adolescent mental wellbeing, we performed multiple regression analyses, using 2004 as the baseline year, with other survey years included as dummy variables (these are called Null models).

Next, we repeated these analyses while controlling gender, age, and family affluence (this is referred to as Model 1). To see if the trends differed between girls and boys, we added an interaction term between survey year and gender in the Model (Model 2). Then, we examined whether differences based on age and socioeconomic status changed over time by including interaction terms between survey year and age (Model 3), and between survey year and family affluence (Model 4). Finally, we tested whether the trends were more pronounced for older adolescent girls by running a Model with a three-way interaction among survey year, gender, and age (Model 5). To check for linear trends over time, we also conducted separate linear regressions with time treated as a continuous variable. All analyses were performed using SPSS version 24.0. We considered results statistically significant if the *p*-value was less than 0.05.

Results

Table I shows the characteristics of the sample. The average age of participants was 13.52 (SD = 1.67) (mean age range from 13.21 in 2022 to 13.80 in 2018). About half of the participants (49.8%) were girls, with yearly percentages ranging from 48.0% in 2022 to 52.4% in 2014. Across most survey years (except 2004 for psychological and somatic symptoms), girls reported significantly higher levels of psychological and somatic symptoms and lower levels of life satisfaction (Tab. II). Overall, mean scores for psychological symptoms were lower than those for somatic symptoms.

Changes over time were recorded for all three wellbeing indicators, but each followed a different trajectory. Life satisfaction was significantly lower in 2014 (B = -0.018; ns) and 2022 (B = -0.443; $p < 0.001$) compared to 2004, but it returned to levels similar to 2004 in 2006 (B = 0.071; ns), 2010 (B = 0.016; *ns*) and increased significantly in 2018 (B = 0.132; $p < 0.004$). Psychological symptoms were significantly lower in all survey years after 2004, with the largest difference being observed in 2010 (B = -1.665; $p < 0.001$) and 2014 (B = -1.653; $p < 0.001$). Similarly, somatic complaints were significantly lower in all waves, with the greatest difference in 2006 (B = -1.013; $p < 0.001$) (Tab. III, Model 1). Linear trend analyses from 2004 to 2022 showed a linear decrease in adolescent across all mental wellbeing measures: life satisfaction (B = -0.05; $p < 0.001$), psychological complaints (B = -0.217; $p < 0.001$) and somatic complaints (B = -0.075; $p < 0.001$).

Compared to boys, girls reported significantly lower life satisfaction (B = -0.372; $p < 0.001$), and higher levels of psychological (B = 0.353; $p < 0.001$) and somatic symptoms (B = 0.237; $p < 0.001$) throughout the study period. However, changes in the gender gap over time were not consistent across the mental wellbeing indicators. For example, the gap between in life satisfaction between boys and girls was only significantly smaller in 2022 compared to 2004. In contrast, the differences in

Tab. I. Sample characteristics (N = 18,439).

	2004	2006	2010	2014	2018	2022	Total
Participants per survey	3,614	3,405	3,291	2,511	3,087	2,531	18,439
Gender							
Boys (%)	50.5	48.8	51.7	47.6	50.2	52.0	50.2
Girls (%)	49.5	51.2	48.3	52.4	49.8	48.0	49.8
Mean age (SD)[a]	13.51 (1.66)	13.54 (1.66)	13.31 (1.64)	13.75 (1.68)	13.80 (1.64)	13.21 (1.69)	13.52 (1.67)
Mean family affluence (SD)[b]	5.15 (1.75)	5.33 (1.74)	5.97 (1.71)	5.20 (1.73)	5.38 (1.74)	5.10 (1.67)	5.37 (1.75)
Mental health and wellbeing							
Mean life satisfaction (SD)[c]	7.39 (2.02)	7.49 (1.99)	7.57 (1.89)	7.35 (1.89)	7.51 (1.78)	7.03 (1.95)	7.41 (1.93)
Mean psychological symptoms (SD)[d]	2.64 (0.54)	1.02 (0.85)	0.97 (0.82)	1.01 (0.87)	1.10 (0.90)	1.22 (1.02)	1.37 (1.05)
Mean somatic symptoms (SD)[d]	2.49 (0.95)	1.48 (0.96)	1.49 (0.97)	1.54 (1.06)	1.69 (1.06)	1.94 (1.10)	1.78 (1.08)

FAS: Family Affluence Scale. [a] Range age 10.58-16.50; [b] Range FAS scale 0-9; [c] Range scale 0-10; [d] Range 0-4.

Tab. II. Marginal estimated means for life satisfaction and health symptoms by gender (N = 18,439).

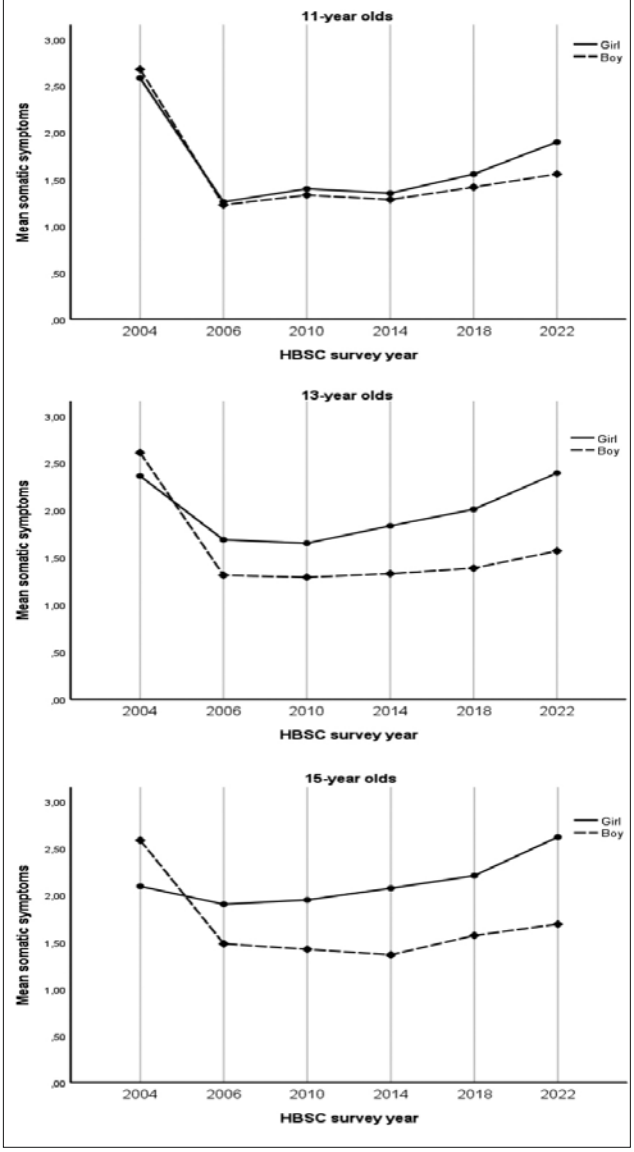
	2004	2006	2010	2014	2018	2022
	Mean (95% CI)[a]	Mean (95% CI)[a]	Mean (95% CI)[a]	Mean (95% CI)[a]	Mean (95% CI)[a]	Mean (95% CI)[a]
Boys						
Mean life satisfaction[b]	7.58 (7.49-7.66)	7.70 (7.61-7.78)	7.62 (7.53-7.70)	7.61 (7.51-7.71)	7.72 (7.63-7.81)	7.34 (7.24-7.44)
Mean psychological symptoms[c]	2.68 (2.64-2.71)	0.84 (0.81-0.88)	0.82 (0.79-0.86)	0.77 (0.73-0.81)	0.91 (0.87-0.94)	0.89 (0.85-0.93)
Mean somatic symptoms[c]	2.63 (2.58-2.67)	1.33 (1.029-1.38)	1.35 (1.30-1.39)	1.32 (1.26-1.37)	1.45 (1.40-1.50)	1.61 (1.56-1.67)
Girls						
Mean life satisfaction[b]	7.30 (7.21-7.39)	7.32 (7.23-7.41)	7.29 (7.20-7.39)	7.23 (7.13-7.34)	7.42 (7.32-7.52)	6.65 (6.54-6.76)
Mean psychological symptoms[c]	2.61 (2.57-2.65)	1.18 (1.14-1.22)	1.13 (1.09-1.18)	1.21 (1.17-1.26)	1.26 (1.22-1.31)	1.62 (1.57-1.67)
Mean somatic symptoms[c]	2.34 (2.30-2.39)	1.61 (1.56-1.66)	1.66 (1.61-1.71)	1.71 (1.65-1.76)	1.89 (1.84-1.94)	2.33 (2.27-2.39)

[a]Adjusted by age and family affluence; [b]range scale 0-10; [c]range 0-4

psychological symptoms between boys and girls were significantly larger in all survey years compared to 2004 and the same pattern was observed for somatic symptoms. Three-way interaction analyses were run (survey year × gender ×age; not shown in Table III) showing that increases in psychological complaints were stronger for older adolescent girls across survey years: 2006 (B = 0.06; < 0.001), 2010 (B = 0.08; < 0.001), 2014 (B = 0.12; $p < 0.001$), 2018 (B = 0.10; $p < 0.001$) and 2022 (B = 0.19; $p < 0.001$) (Fig. 2). A similar pattern was observed for somatic symptoms: 2006 (B = 0.10; < 0.001), 2010 (B = 0.12; $p < 0.001$), 2014 (B = 0.15; $p < 0.001$), 2018 (B = 0.12; $p < 0.001$) and 2022 (B = 0.15; $p < 0.001$), as well as for life satisfaction, which decreased more for older adolescents: 2006 (B = -0.14; < 0.001), 2010 (B = -0.10; $p = 0.01$), 2014 (B = -0.17; $p < 0.001$), 2018 (B = -0.11; $p = 0.01$) and 2022 (B = -0.11; $p = 0.02$) (Figs. 1, 3).

Overall, with increasing age, adolescents in Tuscany reported lower life satisfaction (B = -0.195; $p < 0.001$, Tab. II, Model 1) and higher psychological (B = 0.044; $p < 0.001$) and somatic symptoms (B = 0.064; $p < 0.001$). Over time, the differences between younger and older adolescents increased for psychological and somatic symptoms (Tab. III, Model 3). In contrast, the age gap for life satisfaction remained mostly stable, except in 2006, when it decreased slightly (B = -0.06; $p = 0.026$).Higher family affluence was associated with greater life satisfaction (B = 0.112; $p < 0.001$). The link between family affluence and psychological symptoms was found only in 2014 compared to 2004 (B = 0.025; $p = 0.039$), while for somatic symptoms in all survey years except for 2014. Regarding life satisfaction, the differences related to family affluence decreased only in 2022 compared to 2004 (B = -0.061; $p = 0.033$).

Fig. 1. Trends over time in somatic symptoms by gender and age.



Discussion

This study investigated trends in three key indicators

Tab. III. Time trends in life satisfaction, psychological and somatic symptoms: interaction effects with gender, age and family affluence (N = 18,439).

Main effects		Life satisfaction			Psychological symptoms			Somatic symptoms		
		B	SE	*p*-value	B	SE	*p*-value	B	SE	*p*-value
Null models	2006 (ref. 2004)	0.10	0.05	0.03	-1.625	0.02	< 0.001	-1.01	0.02	< 0.001
	2010 (ref. 2004)	0.176	0.05	< 0.001	-1.674	0.02	< 0.001	-0.996	0.02	< 0.001
	2014 (ref. 2004)	-0.045	0.05	0.375	-1.628	0.02	< 0.001	-0.948	0.03	0.120
	2018 (ref. 2004)	0.123	0.05	0.01	-1.545	0.02	< 0.001	-0.797	0.03	< 0.001
	2022 (ref. 2004)	-0.357	0.05	< 0.001	-1.421	0.02	< 0.001	-0.55	0.03	< 0.001
Model 1	2006 (ref. 2004)	0.071	0.05	0.11	-1.63	0.02	< 0.001	-1.013	0.02	< 0.001
	2010 (ref. 2004)	0.016	0.05	0.73	-1.665	0.02	< 0.001	-0.98	0.02	< 0.001
	2014 (ref. 2004)	-0.018	0.05	0.71	-1.653	0.02	< 0.001	-0.974	0.03	< 0.001
	2018 (ref. 2004)	0.132	0.05	0.004	-1.56	0.02	< 0.001	-0.815	0.02	< 0.001
	2022 (ref. 2004)	-0.443	0.05	< 0.001	-1.393	0.02	< 0.001	-0.515	0.03	< 0.001
	Gender (ref. boys)	-0.372	0.03	< 0.001	0.353	0.01	< 0.001	0.237	0.01	< 0.001
	Age (continuous)	-0.195	0.008	< 0.001	0.044	0.004	< 0.001	0.064	0.004	< 0.001
	FAS (continuous)	0.112	0.008	< 0.001	0.005	0.003	0.15	0.001	0.004	0.795
Interaction effects										
Model 2	2006×gender	-0.118	0.09	0.19	0.413	0.04	< 0.001	0.567	0.05	< 0.001
	2010×gender	-0.056	0.09	0.53	0.379	0.04	< 0.001	0.592	0.05	< 0.001
	2014×gender	-0.133	0.10	0.18	0.533	0.04	< 0.001	0.691	0.05	< 0.001
	2018×gender	-0.071	0.09	0.44	0.453	0.04	< 0.001	0.750	0.05	< 0.001
	2022×gender	-0.385	0.10	< 0.001	0.775	0.042	< 0.001	0.976	0.05	< 0.001
Model 3	2006×age	-0.06	0.03	0.026	0.045	0.01	< 0.001	0.176	0.01	< 0.001
	2010×age	-0.001	0.03	0.96	0.047	0.01	< 0.001	0.141	0.01	< 0.001
	2014×age	0.014	0.03	0.642	0.072	0.01	< 0.001	0.172	0.02	< 0.001
	2018×age	-0.002	0.03	0.952	0.070	0.01	< 0.001	0.167	0.02	< 0.001
	2022×age	-0.008	0.03	0.78	0.102	0.01	< 0.001	0.163	0.02	< 0.001
Model 4	2006×FAS	-0.011	0.03	0.67	-0.007	0.01	0.52	-0.053	0.01	< 0.001
	2010×FAS	-0.046	0.03	0.08	0.014	0.01	0.21	-0.047	0.01	0.001
	2014×FAS	-0.054	0.03	0.06	0.025	0.01	0.039	-0.027	0.01	0.07
	2018×FAS	-0.038	0.03	0.154	0.002	0.01	0.88	-0.044	0.01	0.001
	2022×FAS	-0.061	0.03	0.033	0.015	0.01	0.21	-0.050	0.02	0.001

FAS: Family Affluence Scale; Models 2, 3 and 4 are controlled for main effects of survey year, gender, age, and family affluence, respectively.

of adolescent mental wellbeing using regionally representative cross-sectional data from the Tuscany Region (2004, 2006, 2010, 2014, 2018 and 2022). Moreover, it also explored whether gender, age, and family affluence may have influenced these trends. The main finding shows that adolescent mental wellbeing in Tuscany evolved between 2004 and 2022 across all three indicators, with each indicator exhibiting a distinct pattern of change over time.

Throughout the entire period analyzed, adolescent mental wellbeing showed a linear decline, specifically in life satisfaction, psychological complaints, and somatic complaints. Compared to 2004, life satisfaction was significantly lower in 2014 and 2022, though it rebounded to levels similar to 2004 in 2006, 2010, and notably in 2018. Compared to 2004, psychological symptoms were significantly lower in all subsequent years, with the largest decline observed in 2010 and 2014. Similarly, somatic complaints decreased significantly in all survey years, with the most substantial difference seen in 2006. Adolescent wellbeing is a growing public health concern worldwide. Since the early 21st century, a decline in adolescent emotional wellbeing, such as lower life satisfaction, increased emotional symptoms, and more psychosomatic health complaints, has been observed in high-income countries such as Denmark, Sweden, Iceland, the UK, and the United States [15-17]. A study examining in adolescent wellbeing trends over time (2005-2009-2013-2017) in the Netherlands, a country where young people have consistently reported one

Fig. 2. Trends over time in psychological symptoms by gender and age.

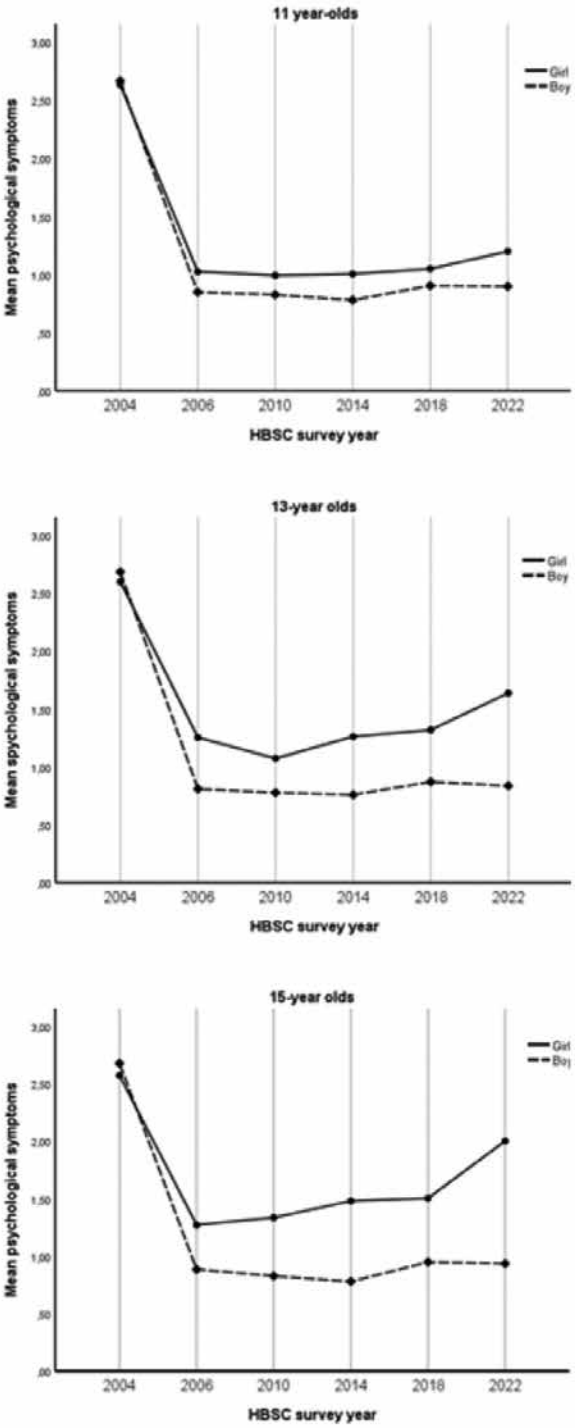
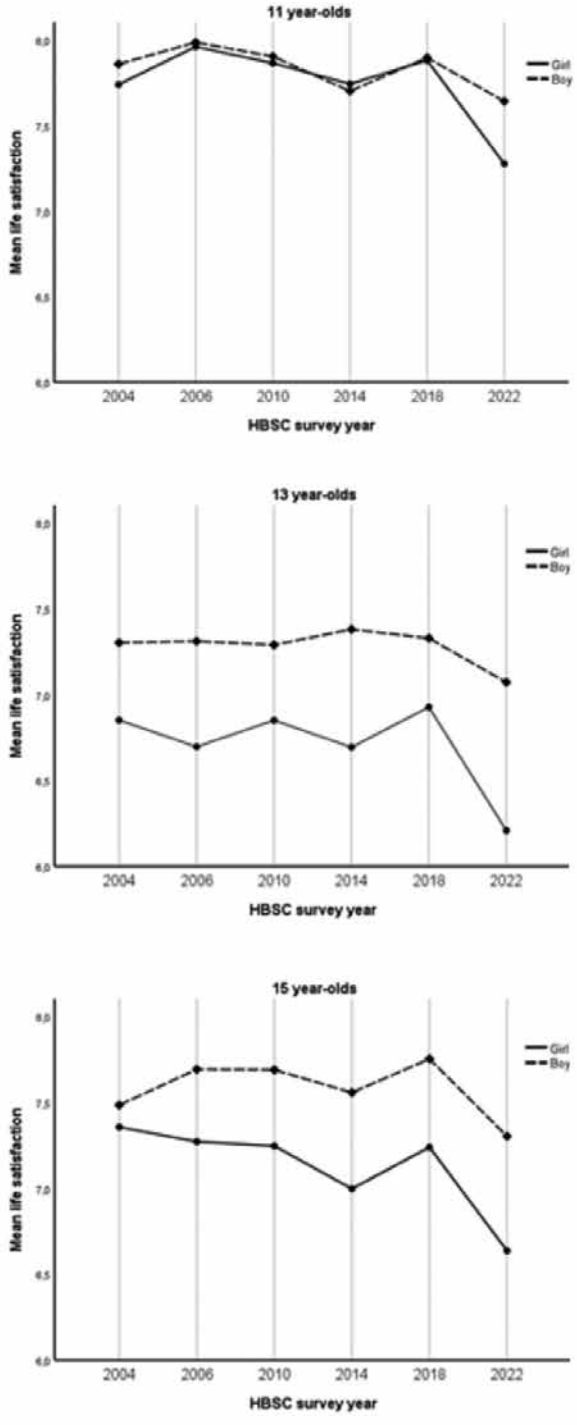


Fig. 3. Trends over time in life satisfaction by gender and age.



of the highest levels of wellbeing in Europe, found a slight decline in mental wellbeing among adolescents between 2009 and 2013 [18]. While time trends in adolescent mental wellbeing in the Czech Republic between 2002 and 2018 did not provide evidence for substantial temporal changes in mental wellbeing among adolescents. Specifically, there was a consistent increase in the prevalence of psychological symptoms from 2002 onwards, while life satisfaction declined until 2014, followed by an increase from 2014 to 2018. Regarding somatic complaints, these rose until 2010, after which a subsequent improvement was observed [19]. The 2022 HBSC Tuscany report highlights how diverging trends in psychological complaints, somatic complaints, and life satisfaction reinforce the idea that adolescent mental wellbeing is not a unidimensional construct. These different components of mental wellbeing can follow distinct trajectories and may have varying

susceptibilities. Life satisfaction, reflecting global cognitive evaluations of one's life, can be seen as a broad indicator of subjective wellbeing, therefore influenced by wider life experiences and relationships. In contrast, psychosomatic complaints may reflect immediate stress symptoms, which, when more severe, can impair daily functioning and may be linked to internalizing disorders. Additionally, emotional components of wellbeing, such as psychological complaints, tend to fluctuate more than life satisfaction, which is generally considered a more stable aspect [19]. These findings underscore the importance of viewing mental wellbeing as a multidimensional construct and highlight the need for a deeper understanding of the associations between risk factors and different aspects of mental wellbeing. To address this, the Governmental Council for Mental Health has been established, with one of its goals being to monitor and promote the mental wellbeing of young people.

The low levels of life satisfaction observed in this study in 2022 may be attributed to the negative effects of the COVID-19 pandemic on adolescents lives, as also reported in other studies [20, 21].

A large survey in Oslo revealed a marked decline in the proportion of adolescents reporting high life satisfaction during COVID-19 school closures compared with pre-pandemic levels. Specifically, rates dropped from approximately 88-92% before the pandemic to around 62-71% during periods of restriction, varying by gender, indicating a substantial decrease in subjective well-being associated with pandemic conditions [22]. Similarly, another study comparing adolescents before and during the pandemic found lower life satisfaction during the pandemic, alongside reduced physical activity, both factors well-established as correlates of overall well-being [23]. During the pandemic, a decline in life satisfaction of adolescents was noted, accompanied by an increase in depressive symptoms, increased distress, subjective well-being, reduced optimism, and increased sadness. Prior to the pandemic, no significant differences in life satisfaction were found among younger adolescents across European countries, with Polish adolescents reporting the highest levels of life satisfaction in relation to overall family climate, alongside Norwegian adolescents [20, 21, 24-29].

Our data highlights that, compared to boys, girls consistently reported significantly lower life satisfaction, along with more psychological and somatic symptoms throughout the study period. However, the gender gap over time was not consistent across the mental wellbeing indicators. For instance, the gap in life satisfaction between boys and girls was significantly smaller only in 2022 compared to 2004. In contrast, the gender differences in psychological symptoms were significantly larger over time in all years when compared to 2004. A similar trend was observed for somatic symptoms. This finding aligns with previous research indicating that girls are more likely to report poorer mental well-being outcomes and supports evidence [19, 29] showing rising trends in emotional problems [30] or psychological and somatic symptoms [6] among girls only. The widening gender gap over time may be attributed to factors such as exposure to societal gender role expectations and the distinct roles assigned to women and men, alongside gender-specific stressors. Additionally, considerable evidence suggests that girls are expected to exhibit greater emotional sensitivity [31], face more restrictive gender roles and body dissatisfaction [32, 33] and are more likely to experience and communicate health symptoms [34], or experience higher school performance pressure [35] but potential underlying mechanisms for such trends are yet to be examined. This study investigates cross-national time trends in adolescent mental well-being (psychosomatic health complaints and life satisfaction, all of which may contribute to the gender disparities in mental well-being observed among adolescents in the Tuscany Region and in other countries such as the Czech Republic [19]. Notably, the smaller gap in life satisfaction between boys and girls reported in 2022 only compared to 2004 may be associated with the impact of the COVID-19 pandemic, which affected both genders. These findings are consistent with other studies reporting a decline in adolescents life satisfaction during the lockdown [36-40]. While some studies suggested that girls, including adults, were more negatively affected than boys [41], others report the opposite [42].

Our results indicate that the increase in psychological complaints has been more pronounced among older adolescent girls in 2006, 2010, 2014, 2018, and 2022. A similar trend was observed for somatic symptoms and life satisfaction during these years. Overall, as adolescents aged, those in Tuscany reported lower levels of life satisfaction and higher levels of psychological and somatic symptoms. However, the differences between younger and older adolescents have increased over time only for psychological and somatic symptoms. In contrast, the age gap in life satisfaction remained stable throughout the study period, except in 2006, when the age difference in life satisfaction decreased. These findings partially align with a study [19], which found that older adolescents were more likely to report poor mental wellbeing, and this age gap has increased over time, although not for all outcomes. Specifically, the differences between younger and older adolescents have increased over time only for psychological symptoms. For life satisfaction and somatic symptoms, the age gap remained stable throughout the study period, except in 2006, when the age gap increased for life satisfaction. Moreover, the increase in psychological complaints had been most pronounced among older adolescent girls, as also highlighted by a review [4] evaluates evidence on whether the population prevalence of child and adolescent mental health problems has changed. The primary focus of the review is on epidemiological cross-cohort comparisons identified by a systematic search of the literature (using the Web of Knowledge database evaluating whether the population prevalence of child and adolescent mental health problems has changed. This body of evidence suggests that this trend is not something to be considered as a national

phenomenon [19] but warrants greater attention. A comprehensive understanding of trends in child and adolescent psychopathology is essential for shaping public health priorities and assessing progress in addressing the burden of childhood psychiatric disorders. However, findings from various studies are not always consistent. For instance, in Norway, an increasing trend in health complaints among adolescents from 1994 to 2014 was observed, particularly among older adolescent girls [6]. In Sweden, an increase in psychological complaints over time (1985 to 2005) was noted in older adolescents (boys and girls), while no significant change was seen in the youngest groups (11-year olds) [43]. Considering these mixed results, there is a clear need for a more comprehensive study that includes multiple countries over a longer time frame and uses a consistent set of mental health and wellbeing outcomes for boys, girls, adolescents of different age groups, and socioeconomic backgrounds [19]life satisfaction.

This study found a positive association between higher family affluence and higher levels of life satisfaction. The relationship between family affluence and psychological symptoms was observed only in 2014 compared to 2004, while associations with somatic symptoms were found in all years except 2014. For life satisfaction, the differences decreased by 2022 compared to 2004. Family affluence plays a crucial role in adolescent well-being and is a potential source of health inequalities. A cross-national comparative analysis conducted among adolescents aged 11 to 15 years in 45 countries during 2017-2018 found a positive association between life satisfaction scores and high family support across all 45 countries [44]. In the majority of countries, living with both parents and having higher levels of family affluence positively influenced adolescent life satisfaction, both directly and indirectly, through family support. These findings highlight that the path system of relationships, which exist between family support, family structure, and family affluence controlling for gender and age, are a key factor in predicting the level of adolescent life satisfaction. In fact, socioeconomic status is a significant determinant of adolescent well-being. Cross-national evidence from the HBSC study shows that adolescents from less affluent families report significantly lower life satisfaction than their more affluent peers [45].

High life satisfaction is important for the overall quality of adolescents' life and for their mental health in general. As such, promoting high life satisfaction for all adolescents, while addressing their health needs based on age and gender, should be a major priority in public health and social policy. Additionally, prevention and intervention programs aimed at improving adolescent well-being could be enhanced by incorporating strategies that help parents recognize and understand the significance of family support in fostering their child's emotional development, happiness, and life satisfaction.

A key strength of the present study is investigating representative samples of adolescents using identical study protocols across a 16-year period. Nonetheless, this inherently fosters the limitation that data collected across time is cross-sectional and self-reported and no causality can be inferred. The measures used were restricted to those available in the HBSC study since 2002, therefore providing a relatively limited perspective on adolescent mental health. Further research should include a broader range of mental health outcome measures and other potential drivers of mental health trends, such as changes in the school or family environment, or social media use, which are required to better understand this complex issue. Nonetheless, the present study provides essential and up-to-date information about changing mental health trends in early adolescence.

Conclusion

These findings indicate that the rise in psychological health issues should be viewed as a public health concern. It is positive that life satisfaction did not decline further and even showed some improvement. To better identify factors influencing adolescent mental wellbeing, ongoing longitudinal research and monitoring of health trends are essential. Additionally, our results emphasize the importance of sustained efforts in primary prevention and promoting adolescent wellbeing, taking into account age and gender differences, as well as initiatives to improve mental health awareness.

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Ethics approval

This study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Ethical Board of the National Institute of Health (General protocol: PRE-876/17) on 10 November 2017.

Consent to participate

Informed consent was obtained from all subjects involved in this study.

Conflicts of interest statement

The authors have explicitly stated that they have no known financial interests or personal affiliations with third parties that could potentially impact the outcome of this study.

Availability of data and material

Data presented in this study are available in accordance with the 2022 Italian HBSC data access policy. Requests should be directed to the Italy Principal Investigator, Prof. Giacomo Lazzeri: giacomo.lazzeri@unisi.it.

Authors contributions

GL: Conceptualization, Methodology, Resources, Data Curation, Supervision, Project Administration and Funding Acquisition; AP: Formal Analysis; AM, DL, RS, GL: Investigation; AM, CMT, GL: Writing-original draft, Writing-review and Editing; AM, CMT, DL, AP, RS, GL: Visualization.

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