

Toward a One Health Framework for Understanding Adolescents' Mental Well-Being in Europe

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I. Introduction

Adolescent mental health and well-being have emerged as major public health concerns, with evidence indicating declining trends over the past two decades [1, 2]. Furthermore, since the COVID-19 pandemic, young people appear to have experienced disproportionately poorer mental health outcomes [3], with higher rates reported among specific groups, such as females and those from more deprived backgrounds [4, 5].

Adolescent health and well-being are inherently multifaceted, shaped by a complex interplay of interrelated factors [6]. Despite growing recognition of the interconnectedness of humans, animals, and the environment, much research continues to focus on individual-level determinants, overlooking the impacts of global challenges, such as climate change, on mental health [7]. This narrow focus leaves significant variations and declines in adolescent mental well-being only partially explained.

Moreover, most of the existing research in this field relies on data from a limited number of countries and cross-national evidence remains scarce, largely due to fundamental differences in study design and methodology [2].

These gaps raise critical questions for policymakers, educators, and health professionals regarding what can realistically be achieved to improve young people's well-being through prevention and early intervention.

Using nationally representative samples of adolescents from 33 countries and standardised sampling and data collection methods, the present study provides a unique opportunity to examine current cross-country variations in adolescent subjective mental well-being. It is based on the new data from the European school Survey on Alcohol and other Drugs (ESPAD), which results have just been published. Employing a One Health approach, it explores how individual, emotional, socio-economic, and environmental factors interact to shape the burden of mental health challenges among adolescents.

The aim is to enhance the understanding of the drivers behind declining youth mental health to support informed targeted actions that address modifiable risk factors and leverage existing opportunities for improvement and positive change.

II. Data and Methods

Data were drawn from the ESPAD cross-sectional survey, which has collected comparable information on substance use and risk behaviours affecting young people's health among European adolescent students since 1995. The sample (n = 98,430) includes 16-year-old students from 33 countries who participated in the most recent data collection conducted in 2024.

Independent variables encompass a range of socio-economic and individual factors: self-reported gender, family composition, highest parental education level, perceived family socio-economic status, number of school days missed in the past month, perceived family and friend support, and participation in sports.

The dataset has been supplemented with country-level variables derived from institutional sources to capture key dimensions of environmental exposures and their contribution to emerging mental health issues, following the One Health approach.

Human health and socio-economic dimensions included: Gross Domestic Product (GDP) per capita, Gini Index, public health expenditure as a percentage of GDP, Gender Inequality Index (GII), percentage of the population aged 65 and above, and the Life Evaluation Index from the World Happiness Report.

Ecosystem and animal health dimensions included: per capita greenhouse gas (GHG) emissions, share of urban population, total number of animal species per square kilometer, and share of forest area at country level.

III. Preliminary Findings

The first exploratory analysis, presented in Table 1, consists of a multilevel model grouping observations by country and by school. In the first control model, only the hierarchical levels are included, with no covariates. The second model adds individual-level variables only; the third includes country-level variables only; and the fourth incorporates both sets of variables. In the following step, we will also include school-level variables, calculated from the ESPAD dataset based on the proportion of students within each school displaying specific characteristics.

As regards the selection of country-level variables, we assessed their correlations and excluded those that were strongly correlated with each other. In cases such as the Gender Inequality Index and Urban Population ($\rho = -0.527$), we addressed multicollinearity by introducing an interaction term.

The Gender Inequality Index, together with the Gini Index, yielded the most counterintuitive results: in both cases, higher levels of inequality appear to be associated with greater individual wellbeing. Further checks on this apparent paradox will explore, through interactions and subgroup analyses, the possibility of an *ecological fallacy* [8], whereby these positive coefficients might be capturing the beneficial effects experienced only by specific subgroups that disproportionately benefit from overall inequalities.

Although gender differences in adolescents' mental health have been widely documented, the patterns emerging from this preliminary analysis are particularly striking, revealing that girls consistently report lower levels of well-being. However, this gap may also point to underreported distress among boys, who may be less inclined to recognize or disclose emotional difficulties [9].

The next step will encompass including in the model other factors, which are presumably linked to mental well-being, such as alcohol, tobacco, and substance use, together with prolonged screentime, gaming and social media use [10].

A central takeaway from our initial findings is that fostering young people's psychological well-being should not be viewed as the exclusive task of mental health professionals. Instead, it calls for

integrated, multidisciplinary strategies that broaden intervention opportunities, lessen long-term risks, and help reduce healthcare expenditures [11]. Furthermore, mental well-being should be recognised not as a secondary or contextual factor, but as a fundamental determinant shaping prevention and health promotion efforts. Achieving this goal requires strong collaboration among schools, families, and health services to create supportive environments that enable adolescents to develop emotional competence, resilience, and effective coping skills in the face of daily challenges and broader socioeconomic and ecological pressures.

VARIABLES	(1) Only Intercepts	(2) Individual level only	(3) Country level only	(4) Individual and country levels
Female		-9.464*** (0.145)		-9.467*** (0.145)
Days of School Missed		-1.205*** (0.066)		-1.202*** (0.066)
Sport leisure activities		3.871*** (0.361)		3.863*** (0.361)
Parental education: More than HS		-0.641*** (0.166)		-0.647*** (0.166)
Parental education: Less than HS		-0.828*** (0.205)		-0.840*** (0.205)
Family Well-off: Better off		2.919*** (0.152)		2.914*** (0.152)
Family Well-off: Worse off		-3.978*** (0.268)		-3.976*** (0.268)
Family Support Index		3.961*** (0.130)		3.959*** (0.130)
Friend Support Index		4.664*** (0.133)		4.668*** (0.133)
Living with two biological or adopting parents		0.867*** (0.177)		0.871*** (0.177)
GINI Index			0.553*** (0.166)	0.452*** (0.156)
Current Health Expenditure (%)			-0.053 (0.385)	-0.282 (0.362)
Population aging 65+ (%)			-0.569** (0.261)	-0.596** (0.245)
Gender Inequality Index			2.132*** (0.583)	1.804*** (0.549)
Urban Population (%)			0.305*** (0.073)	0.308*** (0.069)
Gender Inequality Index#Urban Population			-0.034*** (0.008)	-0.029*** (0.008)
GHG			-0.001 (0.318)	0.064 (0.299)
Population density			-0.002 (0.002)	-0.003 (0.002)
Forest Area (%)			0.015 (0.036)	0.005 (0.033)
Constant	54.009*** (0.789)	47.198*** (0.867)	28.430** (11.947)	26.943** (11.261)
ICC (Country)	0.033	0.036	0.013	0.014
ICC (School Country)	0.061	0.059	0.043	0.037
Observations	98,430	98,430	98,430	98,430
Number of groups	33	33	33	33

Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

IV. References

1. Collishaw S. (2015). Annual research review: Secular trends in child and adolescent mental health. *Journal of child psychology and psychiatry, and allied disciplines*, 56(3), 370–393.
2. Cosma, A., Stevens, G., Martin, G., Duinhof, E. L., Walsh, S. D., Garcia-Moya, I., Költő, A., Gobina, I., Canale, N., Catunda, C., Inchley, J., & de Looze, M. (2020). Cross-National Time Trends in Adolescent Mental Well-Being From 2002 to 2018 and the Explanatory Role of Schoolwork Pressure. *The Journal of adolescent health : official publication of the Society for Adolescent Medicine*, 66(6S), S50–S58.
3. Hafstad, G. S., & Augusti, E. M. (2021). A lost generation? COVID-19 and adolescent mental health. *The lancet. Psychiatry*, 8(8), 640–641.
4. Yoon, Y., Eisenstadt, M., Lereya, S. T., & Deighton, J. (2023). Gender difference in the change of adolescents' mental health and subjective wellbeing trajectories. *European child & adolescent psychiatry*, 32(9), 1569–1578.
5. Deighton, J., Lereya, S. T., Casey, P., Patalay, P., Humphrey, N., & Wolpert, M. (2019). Prevalence of mental health problems in schools: poverty and other risk factors among 28 000 adolescents in England. *The British journal of psychiatry : the journal of mental science*, 215(3), 565–567.
6. Kuntsche, E., & Ravens-Sieberer, U. (2015). Monitoring adolescent health behaviours and social determinants cross-nationally over more than a decade: introducing the Health Behaviour in School-aged Children (HBSC) study supplement on trends. *European journal of public health*, 25 Suppl 2, 1–3.
7. Coffey, Y., Bhullar, N., Durkin, J., Islam, M. S., & Usher, K. (2021). Understanding eco-anxiety: A systematic scoping review of current literature and identified knowledge gaps. *The Journal of Climate Change and Health*, 3, 100047.
8. Connolly, P. (2006). Summary statistics, educational achievement gaps and the ecological fallacy. *Oxford Review of Education*, 32(02), 235-252.
9. Cosma, A., Martin, G., de Looze, M. E., Walsh, S. D., Paakkari, L., Biltz, L., Gobina, I., Page, N., et al. (2025), 'Cross-national trends in adolescents psychological and somatic complaints before and after the onset of COVID-19 pandemic', *Journal of Adolescent Health* 76(2), pp. 254-264.
10. Santos, R. M. S., Mendes, C. G., Sen Bressani, G. Y., de Alcantara Ventura, S., de Almeida Nogueira, Y. J., de Miranda, D. M., & Romano-Silva, M. A. (2023). The associations between screen time and mental health in adolescents: a systematic review. *BMC psychology*, 11(1), 127.
11. Colizzi, M., Lasalvia, A. and Ruggeri, M. (2020), 'Prevention and early intervention in youth mental health: is it time for a multidisciplinary and transdiagnostic model for care?', *International Journal of Mental Health Systems* 14(23).