Exploring shared and unique factors linked to adolescent mental health and wellbeing in a national survey of 11–16-year-olds in Wales.

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Implications and Contribution

This study shows how explanatory variables such as sleep, body image, and social support affect young people's mental health and wellbeing in Wales. Using data from over 176,000 students, it highlights key areas for intervention. The findings help schools and services better target support to improve outcomes for adolescents across the country.

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Disclosure of interests

All authors disclose no conflict of interests

Abbreviations

MH: mental health

WB: mental wellbeing

SHRN: School Health and Research Network

SWEMWBS: Short Warwick-Edinburgh Mental Wellbeing Scale

SDQ: Strengths and Difficulties Questionnaire

SDQTD: Strengths and Difficulties Questionnaire Total Difficulties

WHO: World Health Organisation

MI: Multiple imputation

Abstract

Purpose

Mental health (MH) and mental wellbeing (WB) are related but distinct, potentially shaped by shared or unique factors. Understanding how influences like bullying, body image, and peer support affect each can guide more targeted interventions.

Methods

The School Health Research Network includes 176,603 pupils from 196 secondary schools in Wales (94% coverage of all schools). Bi-annual pupil health survey data were used to explore the relationship between MH (i.e., Strengths and Difficulties Questionnaire Total Difficulties) and WB (i.e., Short Warwick-Edinburgh Mental Wellbeing Scale) using structural equation modelling. Explanatory variables hypothesised to influence MH or WB were grouped into demographic, behavioural, and social domains. Any 11-to 16-year-old pupils with a pair of MH and WB scores in the 2019 or 2021 survey (N=176,603) were included.

Results

Explanatory variables from each domain were adversely associated with MH and WB. Difficulties sleeping had the strongest adverse effect on WB (β=0.18, 95%CI=0.13 to 0.23, p<0.001) and MH (β=0.21, 95%CI=0.16 to 0.26, p<0.001). The strength of this association did not differ significantly between the two outcomes. There was no evidence of an effect of school on MH or WB indicating that the individual-level effects may not directly be influenced by schools.

Discussion

Key modifiable explanatory variables e.g., academic pressure, body image, and lack of support from friends and teachers could serve as targets for interventions for MH and WB. Further development with schools, families and health and social care services across Wales could support a more coordinated approach to improving adolescent MH

and WB.

Introduction

Adolescent mental health (MH) and wellbeing (WB) are increasingly recognised as critical areas for research, policy, and intervention[1,2]. MH conditions, including depression, anxiety, and behavioural disorders, have shown rising prevalence among young people and are now among the leading causes of disability worldwide in this age group[3]. Alongside these concerns, WB—characterised by positive states of functioning, life satisfaction, and resilience—plays a vital role in fostering healthy development and has implications for future MH and life outcomes[4,5]. Despite the intertwined nature of MH and WB, they are not simply opposite ends of a single continuum. Instead, they represent overlapping but distinct dimensions that may be influenced by unique or shared predictors[6]. This distinction is important, as it may inform tailored intervention strategies that either address specific risk factors or promote protective factors across both dimensions.

Our previous study (currently available as a preprint)[7], found a significant negative dose-response relationship between MH difficulties and WB among children aged 11-16 in Wales, indicating that as the severity of MH difficulties increased, WB worsened, even after accounting for demographic, behavioural, and social factors. This underscores the importance of early intervention and tailored support strategies, as addressing MH issues at varying levels of severity can significantly enhance overall WB[8]. Gaining an understanding of whether prevention and treatment techniques for MH and WB are distinct or overlapping can significantly enhance the allocation of efforts and resources.

Identifying variables associated with adolescent MH and WB has the potential to improve our understanding of risk and resilience during this critical developmental stage. Previous research has identified numerous explanatory variables associated with MH and WB, including demographic factors[9], social influences[10,11], and behavioural factors[12]. However, it is unclear whether these variables operate similarly across both MH and WB domains or whether they exhibit specificity to one over the other[13]. Understanding the extent to which variables overlap or diverge across these two domains is essential for designing targeted interventions that address the unique needs of adolescents at different levels of risk or with different resilience profiles.

The aim of this study is to identify both common and unique explanatory variables associated with adolescent MH and WB. This study will seek to overcome sample bias in previous studies by using a nationally representative survey of Welsh schoolchildren aged 11-16 years, responding to questions about their MH and WB. The School Health and Research Network (SHRN)[14] includes comprehensive data on social and economic confounders at an individual, family and household level. This study examines whether factors influencing MH and WB operate similarly across both domains or exhibit outcome-specific effects. By disentangling these relationships, the study will enhance our understanding of shared and distinct influences, thereby informing the development of more targeted and effective prevention and intervention strategies. We also involved a group of young people in a public engagement workshop to help validate and contextualise the study findings.

METHOD

Design and Sample

This study is a secondary data analysis of two iterations of the School Health Research Network's (SHRN) biennial Student Health and Wellbeing survey 2019/20[15], and 2021/22[16]. SHRN was set up in 2013 by Cardiff University, Welsh Government, Public Health Wales and other partners with the intention of understanding and improving the health and wellbeing of children and adolescents in Wales. All maintained secondary and middle schools in Wales have been registered with SHRN. Since 2017, SHRN has collected anonymised, individual-level data relating to the views of schoolchildren aged 11-16 in their survey. Questions were delivered electronically in schools and available in English and Welsh. Participants selected their preferred language. The Welsh version was produced using a standardised translation process to ensure conceptual and measurement equivalence with the English version. In the 2019/20 survey, 119,388 pupils from 198/210 schools in years 7 to 11 responded to the survey (77% response rate). In the 2021/22 survey, 123,204 pupils from 202/212 schools in years 7 to 11 responded to the survey (75% response rate). Students who completed either the 2019/20 or

2021/22 surveys were included in the study. On the occasion where students completed both surveys, their responses from the 2021/22 survey were included.

Ethics

Ethical approval for Student Health and Wellbeing surveys (2017–23) was obtained from Cardiff University's School of Social Sciences Research Ethics Committee. Further details regarding the ethical considerations and approvals for this study are available here[14]**.**

Explanatory variables

We focused on three domains, Demographic, Behavioural, and Social, as proximal and modifiable influences on adolescent MH and WB within socio-ecological models[17]. Variables were chosen for theoretical salience[18], common use in adolescent research[19], and availability in the SHRN survey[14]. Included variables were: Demographic domain: age, gender, ethnicity, survey year; Behavioural domain: smoking, vaping, alcohol use, energy drinks, physical activity, weekday sedentary time, sleep difficulties, bedtime routine; Social domain: body image, family/peer support, bullying (victim/perpetrator), academic pressure, school support/teacher care, family affluence, living away from home (reflecting the protective role of connectedness)[14]. Some predictors (e.g., prior diagnosis, counselling) were not measured in this SHRN wave; ACEs were also unavailable (though strongly related to later mental health)[20]. Screen time was excluded due to the small and mixed associations reported in previous research.[21] We therefore incorporated sedentary time as a general indicator of low-activity behaviours, recognising that it encompasses a wider range of activities than screen use and is not a direct proxy or interchangeable construct. Further information on the explanatory variables is provided in Supplementary Material (S1. pp. 1-5).

Outcome variables

Strengths and Difficulties Questionnaire (SDQ)

The Strengths and Difficulties Questionnaire (SDQ)[22] is a short behavioural screening questionnaire for 2–17-year-olds commonly used as a screening tool for MH problems. It has been shown to be effective in differentiating cases with mental illness from those without mental illness (AUC 0.83) and in identifying MH disorders, such as oppositional or conduct disorders (AUC 0.77)[23]. Concurrent criterion validity was assessed insofar as it was found to be able to distinguish between paediatric dental and psychiatric populations[22]. The SDQ Total Difficulties score is calculated by summing the score from four of the five SDQ subscales: emotional problems, conduct problems, hyperactivity, and peer problems. Further information is included in the Supplementary Material (S2, pp. 5-6).

Short Warwick-Edinburgh Mental Wellbeing Scale (SWEMWBS)

The 7-item Short Warwick-Edinburgh Mental Wellbeing Scale (SWEMWBS) was designed to monitor WB in the general population[24]. Items are scored 1–5 and summed (raw range 7–35; higher scores indicate greater WB). Despite being intended for population monitoring, SWEMWBS has been validated in adolescents[21]. There is no minimal important difference for SWEMWBS. We report effect sizes and 95% CIs rather than applying a fixed threshold. Further details, including reliability and validation evidence are provided in the Supplementary Material (S2. p. 6).

Analysis

Structural equation modelling

Structural equation modelling (SEM) was employed to investigate the association between MH (measured by SDQ) and WB (measured by SWEMWBS). Given the strong association found previously between MH and WB, latent variables for each of the outcomes were created. This approach allows for the estimation of residual covariance between the latent outcome variables while also regressing both outcomes onto a comprehensive set of explanatory variables from demographic, behavioural, and social domains. The model accounted for the clustering of data by school identifier, using a multilevel SEM approach to control for the nested structure of the data, allowing for the examination of both within- and between-school effects. The model was estimated using maximum likelihood

estimation, and model fit was assessed using Comparative Fit Index (CFI)[25], Tucker-Lewis Index (TLI)[26], Root Mean Square error of Approximation (RMSEA)[27]. CFI and TLI values close to 1 indicate good fit with values over 0.95 considered excellent, while an RMSEA value below 0.06 indicates excellent fit.

Interpretation

Estimates are presented as standardised regression coefficients indicating the magnitude and direction of each predictor's association with MH and WB. Latent outcomes and explanatory variables were standardised and therefore can be interpreted as effect sizes. This standardisation allows for a direct comparison of the relative importance of different variables, as the estimates are expressed in standard deviation units. Consequently, larger absolute values of these standardised estimates indicate stronger effects.

Dealing with missing data

To maximise sample size, this analysis was based on core questions asked to all individuals in SHRN. Since using complete case analysis can result in biased estimates[28], we examined patterns of missingness and applied multiple imputation (MI)[29]. The missing at random assumption was made more plausible by including socio-demographic variables in the imputation model. To assess whether missingness was systematic, we ran multiple logistic regression predicting non-completion of SWEMWBS from demographic, behavioural, and social variables (Supplementary Table S1, pp 7-8). Results show that missingness was associated with variables from all domains, indicating that data were not Missing Completely at Random. This informed our decision to use MI under the MAR assumption, incorporating all predictors of missingness into the imputation model. MI was based on 176,603 individuals who provided complete information on SWEMWBS and SDQ at either of the 2019/20 or 2021/22 surveys and had incomplete information on any of the explanatory variables. The imputation process generated 25 datasets by 5 cycles of regression models, and results were pooled using Rubin's rules[30].

Sensitivity analyses

Sensitivity analyses were conducted on the complete case sample (N=126,538), 2019 survey (N=87,264), and 2021 survey (N=89,339) to ensure the robustness of the findings.

Public engagement

We held an exploratory workshop with children from single-parent households to understand their views on factors affecting MH and WB and compare these with our findings. The session was facilitated by the lead researcher, with informed consent obtained from participants and guardians. No recordings were made; feedback was captured through observer notes and summarised thematically to identify areas of agreement and divergence with the quantitative results.

RESULTS

Descriptive results

The primary sample consisted of 86,360 males (48.9%), 86,748 females (49.1%), and 3,495 individuals (2.0%) identifying as non-binary. The mean and standard deviation for both the WB and MH outcomes for each category of explanatory variable are presented in Table 1. Overall, pupils in the least optimal categories of all explanatory variables were associated with reduced WB and higher MH difficulties. For example, pupils who didn't report difficulties sleeping had increased WB (M=25.6, SD=4.9) and lower MH difficulties (MH: M=10.5, SD=5.9) compared to pupils who did report difficulties sleeping (WB: M=21.4, SD=5.3; MH: M=16.6, SD=6.4).

[Table 1]

Correlation between explanatory and outcomes variables

Polychoric correlation analysis among the variables was conducted to understand their relationship and assess potential multicollinearity. The correlation matrix revealed various degrees of association between the variables. The vast majority of correlations were weak (i.e., *rho*=0.00 to 0.30, or *rho*=-0.30 to 0.00), suggesting a minimal risk of multicollinearity affecting the SEM estimates. Further information is provided in the Supplementary Material (S3 and Table S2, pp. 9-10).

Structural Equation Modelling: Model fit

The fit of the model was assessed using several fit indices, including the CFI=0.97, TLI=0.97, and RMSEA=0.03. Acceptable model fit was determined based on established cut-off criteria (e.g., CFI and TLI > 0.90, RMSEA < 0.08).

Association between explanatory variables *and outcomes*

Associations between all explanatory variables and both outcomes are summarised in Table 2 and visualised in Figure 1. For clarity, variables are grouped by domain and presented in the same order as in the table and figure. In the demographic domain, female gender was associated with increased MH difficulties (β = 0.08, 95% CI: 0.02–0.14, p < 0.01) and reduced WB (β = 0.12, 95% CI: 0.07–0.18, p < 0.001). Within the behavioural domain, difficulties sleeping was associated with increased MH difficulties (β = 0.21, 95% CI: 0.16–0.26, p < 0.001), and reduced WB (β = 0.18, 95% CI: 0.13–0.23, p <0.001). In the social domain, academic pressure was associated with increased MH difficulties (β = 0.14, 95% CI: 0.09–0.20, p < 0.001), and reduced WB (β = 0.11, 95% CI: 0.06–0.17, p < 0.001). Perceiving teachers as ambivalent about pupils' WB and academic progress were associated with increased MH difficulties (β = 0.07, 95% CI: 0.01–0.14, p <0.05) and reduced WB (β = 0.08, 95% CI: 0.04–0.13, p < 0.01), as was a perceived lack of teacher concern for pupils' WB and academic progress (MH: β = 0.10, 95% CI: 0.00–0.19, p <0.05; WB: β = 0.11, 95% CI: 0.02–0.19, p <0.05). Experiences of bullying were also important: less than weekly was associated with increased MH difficulties (β = 0.13, 95% CI: 0.08–0.19, p <0.001, and reduced WB (β = 0.06, 95% CI: 0.01–0.11, p < 0.05).Finally, perceiving oneself as overweight was associated with increased MH difficulties (β = 0.11, 95% CI: 0.06–0.17, p <0.001) and reduced WB (β = 0.11, 95% CI: 0.06–0.16, p <0.01).

[Table 2]

[Figure 1]

In determining whether there were differences between each predictor and both outcomes, Wald tests were used. Statistical significance was determined using a Wald test threshold of 3.84, which corresponds to a p-value of less than 0.05. None of the tests reached this threshold, indicating that

there was no evidence to suggest that any of the variables were statistically significant different from each other in relation to either outcome.

Residual covariance

A positive standardised residual covariance between MH and WB ($\beta = 0.32$, $p < 0.001$) suggests that as MH difficulties increases, WB declines and vice versa. The residual covariance reported refers to the estimated covariance between the latent variables for MH and WB after accounting for all specified predictors in the structural equation model. This parameter captures the remaining association between MH and WB not explained by the modelled paths.

School level effects on mental health difficulties and wellbeing

In terms of the between-level influence of schools on the outcomes, there was no evidence of an effect of school on MH (β=0.006, 95%CI=-0.004 to 0.015, $p > 0.05$), indicating that the individual-level effects are not directly influenced by schools. A similar pattern was evident for an effect of school on WB (β=-0.002, 95%CI=-0.009 to 0.004, $p > 0.05$). These estimates illustrate the impact of each of the explanatory variables on MH and WB across the entire student population, irrespective of their school affiliation. The absence of significant between-level variance indicates that these individual-level effects are consistent across different schools.

Sensitivity analysis

Findings from the sensitivity analyses, including complete case analysis (Supplementary Material S4. Table S3 and Figure S1, pp. 11-15), 2019 survey (S5. Table S4 and Figure S2, pp. 16-19), and 2021 survey only (S6. Table S5 and Figure S3, pp. 21-25) showed a similar pattern of results to the multiple imputed findings presented in the main text.

Discussion

Summary of results

This study identified explanatory variables impacting MH and WB in 176,603 Welsh pupils aged between 11 and 16 years. Explanatory variables from each of the three domains were associated with increased MH difficulties and reduced WB. Demographic domain: female gender; Behavioural domain: difficulties sleeping; and Social domain: body image of being overweight, academic pressure, bullying victimisation, inadequate care from teachers, and lack of support from friends. The pattern of results was consistent across sensitivity analyses, including complete cases, and specific cohort years. There were no significant differences between the significant explanatory variables and MH and WB outcomes. School-level variation in MH and WB outcomes was small and not statistically significant, suggesting that differences between schools explain little of the variance in these outcomes.

Comparisons with previous studies

This study builds upon previous research by identifying explanatory variables from similar domains associated with adolescent MH and WB, thereby reinforcing and expanding our understanding of these associations. Previous research consistently shows that adolescent girls are more likely than boys to experience MH difficulties[31]. Strong associations have also been reported between sleep problems and poor MH in this age group[32]. Concerns about body image, particularly perceptions of being overweight, are another well-documented risk factor[33]. Academic stress and pressure similarly contribute to MH challenges among adolescents[34]. Being bullied is a significant predictor of poor MH[35], while supportive relationships, including care from teachers and support from friends, are protective for both MH and WB[36].

In our study, standardised betas for each identified explanatory variables indicated a small but significant association with MH and WB. This is not surprising, as previous studies have also found relatively small effect sizes in similar contexts. For example, Shimizu et al. (2021) found that children with persistent sleep problems had significantly higher levels of anxiety and depression in adolescence[37]. These findings highlight that even small effect sizes can be meaningful and have practical implications for individual and population-level interventions aimed at improving adolescent MH and WB. Similarly, effect sizes for social interventions are likely to be smaller as they differ

fundamentally from the short-term, proximal outcomes and controlled laboratory settings studied in many psychology experiments.

Although effect sizes were small, they should not be dismissed; even modest associations can translate into meaningful population-level benefits when applied across large adolescent populations[38]. Focusing on the key explanatory variables (i.e., female, sleep difficulties, negative body image, academic pressure, bullying, inadequate teacher care, and lack of friend support) can provide a comprehensive understanding of the determinants of poor MH and WB in adolescents. Research has shown that these factors are interrelated and can cumulatively impact an adolescent's MH[39]. Addressing these variables through targeted interventions could help mitigate their negative effects. For example, promoting healthy sleep hygiene, fostering positive body image, providing supportive school environments, and encouraging strong peer relationships are promising strategies[40]. Future research should examine whether these factors cluster within individuals and whether universal or targeted interventions yield the greatest benefit. By understanding and addressing these determinants, more effective strategies can be developed to enhance the overall MH and WB of young people.

Although the same set of predictors were associated with both MH difficulties (measured using the SDQ) and WB (measured using the SWEMWBS), we do not interpret this as redundancy. Under the dual-continua model, MH symptoms and WB are related yet distinct, and common proximal determinants in adolescence (e.g., sleep, bullying, school connectedness) can drive convergent prediction even when constructs differ[41]. Empirically, WB and symptom measures in teenagers correlate only moderately (e.g., WEMWBS vs SDQ $r \approx -0.4$ to -0.5), supporting separability rather than duplication[42]. Measurement may also contribute: SWEMWBS shows strong psychometrics and invariance in Welsh school samples, whereas SDQ subscale structure/reliability is more mixed in mid-adolescence, potentially attenuating differences[43]. Practically, this pattern suggests that school-relevant levers (i.e., reducing bullying/academic pressure and strengthening family/school connectedness and sleep) are likely to improve both outcomes[44]. Greater differentiation may emerge

with inclusion (or linkage) of clinical exposures/ACEs and strengths-based assets (e.g., purpose, optimism) in future waves.

School-level variation and implications

Our multilevel analysis found minimal and non-significant variation between schools in MH and WB outcomes after adjusting for demographic, behavioural, and social factors. This suggests that these individual-level determinants operate consistently across school contexts, aligning with prior research showing that personal and family factors often outweigh school-level differences[45,46]. However, school culture (e.g., academic pressure) may still indirectly shape these influences.

From a public health perspective, the absence of strong between-school effects does not diminish the role of schools as delivery platforms for mental health promotion. Schools remain uniquely positioned to provide accessible, stigma-free support and implement universal or targeted interventions addressing key risk and protective factors (e.g., sleep, connectedness, bullying)[45,47]. Integrating such interventions within school settings can maximise reach and equity, even if contextual differences between schools are small. While this study did not set out to evaluate specific school-based programmes, the findings suggest that individual-level factors may play a more prominent role in shaping adolescent MH and WB than school-level differences.

While school-based interventions can promote MH, their effectiveness is highly variable. Meta-analyses of universal social-emotional learning (SEL) programmes report small but positive average effects, moderated by programme quality and implementation fidelity[48]. However, large-scale trials such as the MYRIAD study—a cluster RCT of mindfulness training in UK secondary schools—found no significant benefit over usual provision for adolescent MH outcomes at one year[49]. Implementation factors, such as teacher training, fidelity, and contextual fit, are critical for success[50]. Therefore, rather than advocating blanket adoption, research should guide schools toward evidence-based, well-implemented interventions, ideally within a whole-school approach as recommended by NICE[51].

To further validate our findings, we engaged a group of young people aged 10-14 years to see how they related to our results. The group highlighted several key factors, such as bullying, academic

pressure, and lack of support from family and friends, as crucial for maintaining good MH and WB. When asked, they also recognised the importance of sleep in safeguarding MH and WB. The consistency of these variables across different school environments and their modifiable nature underscores the potential for schools to play a pivotal role in MH interventions.

Strengths and Limitations

This study has several strengths. First, the use of a nationally representative sample enhances the generalisability of the findings. Second, the inclusion of data from both before and after the COVID-19 pandemic provides valuable insights into its impact on child and adolescent MH and WB. Results conducted on the 2019 and 2021 surveys separately revealed similar findings to the analysis conducted on the combined surveys. Third, the use of self-reports, which have been shown to be more accurate predictors of WB and depressive symptoms in adolescence compared to parent-reports[5]. Fourth, the study employs structural equation modelling, which allows for the simultaneous analysis of both outcomes (MH and WB) and all explanatory variables. This approach reduces measurement error, accounts for variance that is not directly observable but inferred from the measured outcome variables and provides more precise estimates. Fifth, because missingness was systematically related to key variables, we used MI under the MAR assumption, including all predictors of missingness in the imputation model. This approach reduces bias compared to complete-case analysis and strengthens confidence in the robustness of our findings.

There are some limitations to this study. First, despite spanning two cohorts of SHRN, it is a cross-sectional study, which limits our ability to infer causality. However, using a nationally representative sample provides a broader generalisability of the findings to the target population, enhancing the study's external validity[52]. Additionally, as an observational cross-sectional epidemiological study, it lacks genetic data, which could provide deeper insights into the hereditary factors influencing MH and WB. Incorporating genetic information could help identify potential gene-environment interactions and improve the overall understanding of disease aetiology[53]. Because exposures and outcomes were measured at the same time, temporality cannot be established, leaving estimates vulnerable to reverse

causation and unmeasured confounding; accordingly, we interpret associations as non-causal and recommend longitudinal/linked replication. Self-reported data may be subject to underreporting of sensitive experiences such as bullying or mental ill-health due to stigma. However, any resulting bias is unlikely to substantially alter our findings for two reasons. First, the SHRN survey was administered anonymously in a classroom setting, which has been shown to reduce social desirability bias compared to interviewer-led modes (Brener et al., 2003). Second, any misclassification is likely to be non-differential with respect to the outcomes, which would bias associations toward the null rather than create spurious relationships.

Although generalisability beyond Wales is uncertain because schooling, services and culture differ elsewhere, our study provides nationally representative, policy-ready estimates and a documented protocol that other jurisdictions can replicate or adapt. The WB outcome uses SWEMWBS, a validated, unidimensional scale with good reliability and construct validity in adolescents, including large Welsh samples showing measurement invariance across school years, and robust psychometrics in wider populations, so our inferences rest on a solid instrument base. That said, as a brief scale it prioritises functioning and overall subjective WB. Future waves could add other measures to capture emotional (hedonic), psychological and social (eudaimonic) WB for richer subdomain analyses. Residual selection/non-response bias and cultural/linguistic nuances may remain despite weighting, yet high engagement and national coverage mitigate these risks. We did not fully examine subgroup heterogeneity or inter-relationships between domains (e.g., sleep, connectedness, climate, mental health); these are planned secondary analyses using SEM, supported by the breadth of variables already collected.

Conclusion

Although the effect sizes were relatively small, they highlight associations between modifiable factors, such as experiences of bullying and lack of support from teachers and friends, and adolescent MH and WB, suggesting these areas warrant further investigation. At the same time, non-modifiable characteristics, such as gender, may help identify groups at greater risk, highlighting the need for

targeted support and inclusive intervention strategies. Creating supportive environments at home, school, and in the community, and addressing variables associated with increased MH difficulties and reduced WB are essential steps in safeguarding the WB of young people. By investing in preventive measures and targeted interventions, adolescents can lead healthier, more fulfilling lives and reduce the long-term burden of mental health conditions on society.

Data disclaimer

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Table 1. Descriptive information for each of the explanatory variables and both outcomes (N=176,603)

Variable	Category	n	%	SWEMWBS (Mean)	SWEMWBS (SD)	SDQTD (Mean)	SDQTD (SD)
Year	*2019*	87264	49.4	23.2	5.5	12.8	6.7
	2021	89339	50.6	24.0	5.5	13.9	6.9
Age	*11-12 years*	59883	33.9	24.3	5.4	12.2	6.9
	13-14 years	73793	41.8	23.4	5.5	13.8	6.8
	15-16 years	42927	24.3	22.8	5.5	14.5	6.6
Gender	*Male*	86360	48.9	24.8	5.3	12.2	6.5
	Female	86748	49.1	22.6	5.4	14.3	6.9
	Non-binary	349	2.0	18.0	5.9	21.1	6.4
Ethnicity	*White*	156900	88.8	23.6	5.5	13.4	6.9
	Asian	4947	2.8	23.9	5.9	11.7	6.5
	Black and Other	12361	7.0	23.6	5.8	13.3	6.8
	Prefer not to say	2395	1.4	22.1	6.0	14.8	7.2
Smoking	*No*	170974	96.8	23.7	5.4	13.2	6.8
	Yes	5629	3.2	19.2	6.6	19.9	6.7
Vaping	*Never*	138093	78.2	24.1	5.3	12.4	6.6
	Tried once	15702	8.9	22.4	5.5	15.7	6.5
	Tried more than once	22808	12.9	21.1	5.7	17.9	6.5
Alcohol consumption	*Never*	101669	57.6	24.4	5.4	11.8	6.6
	Up to 1 drink	34633	19.6	23.1	5.3	14.5	6.6
	2-3 drinks	20708	11.7	22.4	5.4	15.7	6.5
	4+ drinks	19593	11.1	21.5	5.8	17.0	6.6
Energy drinks	*Rarely or never*	145162	82.2	24.0	5.3	12.7	6.6
	Weekly or more	25079	14.2	22.3	5.6	16.0	6.8
	Daily or more	6362	3.6	20.1	7.0	19.0	7.1
Physical activity	*Inactive*	8844	5.0	19.8	6.1	17.7	6.9
	Less active	60664	34.4	22.5	5.3	14.6	6.7
	More active	107094	60.6	24.5	5.3	12.4	6.7
Sleep difficulty	*No*	93800	53.1	25.6	4.9	10.5	5.9
	Yes	82803	46.9	21.4	5.3	16.6	6.4
Body image	*About right*	89299	50.6	25.2	5.0	11.1	6.2
	Too thin	23887	13.5	22.8	5.4	14.5	6.7
	Too fat	63416	35.9	21.6	5.5	16.2	6.6
Family practical	*Yes*	134582	76.2	24.5	5.1	12.4	6.5
	Ambivalent	12537	7.1	20.3	4.8	17.7	5.9
	No	29483	16.7	21.1	6.3	16.2	7.5
Friends support	*Yes*	115511	65.4	24.6	5.1	12.3	6.5
	Ambivalent	19310	10.9	21.8	4.9	15.7	6.3
	No	41782	23.7	21.7	6.1	15.5	7.3
Bullying victimisation	*No*	120043	68.0	24.5	5.2	11.7	6.3
	Less than weekly	42011	23.8	22.3	5.3	15.9	6.4
	At least weekly	14550	8.2	19.9	6.0	19.9	6.7
Bullied others	*No*	151803	86.0	23.9	5.4	12.8	6.7
	Less than weekly	21196	12.0	22.2	5.4	16.5	6.6
	At least weekly	3604	2.0	20.3	6.9	19.6	7.1
School support	*Yes*	114181	64.7	24.8	5.1	11.8	6.
	Ambivalent	39418	22.3	22.3	5.1	15.1	6.3
	No	23004	13.0	20.1	5.9	18.0	6.7
Teachers care	*Yes*	97526	55.2	25.1	5.1	11.4	6.4
	Ambivalent	49044	27.8	22.4	5.0	14.8	6.3
	No	30034	17.0	20.5	6.0	17.6	6.8
Family Affluence Scale	*Lowest*	47698	27.0	22.7	5.6	14.6	6.9
	Middle	65695	37.2	23.6	5.5	13.4	6.8
	Highest	63210	35.8	24.3	5.4	12.5	6.7

Table 2. Estimated standardised regression coefficients from a SEM (multiple imputed sample: N=176,603) examining the associations of significant explanatory variables across the two outcomes: wellbeing (measured by the SWEMWBS scale) and mental health difficulties (measured by SDQ Total Difficulties score).

					Wellbeing					**Mental health**				
Domain	Predictor	Category	Proportion of missing that was imputed	N	Estimate	S.E.	95% CI Lower	95% CI Upper	p value	Estimate	S.E.	95% CI Lower	95% CI Upper	p value
Demographic	Age	11-12 years		59883					Reference					
		13-14 years		73793	-0.03	0.03	-0.09	0.03	0.319	-0.02	0.03	-0.08	0.04	0.427
		15-16 years		42927	-0.04	0.04	-0.11	0.04	0.356	-0.05	0.04	-0.13	0.04	0.263
		Missing	0											
	Gender	Male		86360					Reference					
		Female		86748	0.12	0.03	0.07	0.18	1.15E-05	0.08	0.03	0.02	0.14	0.007
		Non-binary		3495	0.06	0.09	-0.11	0.23	0.494	0.05	0.10	-0.14	0.25	0.585
		Missing	1271 (0.72%)											
	Year	2019		87264					Reference					
		2021		89339	0.04	0.03	-0.01	0.08	0.163	0.05	0.03	-0.02	0.11	0.142
		Missing	0											
	Ethnicity	White		156900					Reference					
		Asian		4947	-0.01	0.07	-0.14	0.12	0.858	-0.04	0.09	-0.20	0.13	0.668
		Black and Other		12361	-0.02	0.06	-0.14	0.11	0.804	-0.02	0.05	-0.13	0.09	0.688
		Prefer not to say		2395	0.02	0.10	-0.18	0.21	0.880	0.00	0.10	-0.20	0.21	0.965
		Missing	0											
Behavioural	Smoking	No		170974					Reference					
		Yes		5629	0.03	0.08	-0.13	0.19	0.738	0.01	0.09	-0.16	0.19	0.880
		Missing	3556 (2.01%)											
	Vaping	Never		138093					Reference					
		Once		15702	0.01	0.04	-0.07	0.09	0.758	0.04	0.05	-0.07	0.14	0.505
		More than once		22808	0.02	0.04	-0.06	0.10	0.589	0.06	0.05	-0.03	0.16	0.194

		Missing	4525 (2.56%)										
	Alcohol consumption	Never		101669					Reference				
		Up to 1 drink		34633	0.01	0.03	-0.05	0.08	0.686	0.05	0.04	-0.02	0.12	0.185
		2-3 drinks		20708	0.01	0.04	-0.08	0.09	0.851	0.04	0.05	-0.05	0.13	0.389
		4+ drinks		19593	0.01	0.05	-0.10	0.11	0.880	0.04	0.06	-0.07	0.15	0.444
		Missing	4080 (2.31%)											
	Energy drinks consumption	Rarely or never		145162					Reference				
		Weekly or more		25079	0.02	0.03	-0.05	0.09	0.554	0.05	0.04	-0.03	0.13	0.251
		Daily or more		6362	0.03	0.07	-0.12	0.17	0.725	0.04	0.08	-0.12	0.20	0.620
		Missing	947 (0.54%)											
	Physical activity	More active		107094					Reference				
		Less active		60664	0.07	0.02	0.02	0.11	0.003	0.03	0.03	-0.03	0.09	0.286
		Inactive		8844	0.07	0.06	-0.05	0.19	0.257	0.03	0.06	-0.08	0.15	0.584
		Missing	6296 (3.57%)											
	Sedentary	0-3 hours		77444					Reference				
		4-6 hours		70155	0.01	0.02	-0.04	0.05	0.808	0.03	0.03	-0.02	0.09	0.243
		>= 7 hours		29004	0.03	0.04	-0.04	0.11	0.395	0.08	0.04	-0.01	0.16	0.070
		Missing	4054 (2.31%)											
	Sleep difficulties	No		93800					Reference				
		Yes		82803	0.18	0.02	0.13	0.23	4.69E-14	0.21	0.03	0.16	0.26	8.88E-16
		Missing	1516 (0.86%)											
	Bedtime	By 10pm		66749					Reference				
		Between 10pm and midnight		82804	0.02	0.03	-0.03	0.07	0.449	0.04	0.03	-0.02	0.09	0.226
		Between midnight and 2am		17187	0.04	0.05	-0.05	0.12	0.423	0.06	0.05	-0.04	0.16	0.260
		2am or after		9864	0.06	0.06	-0.05	0.17	0.306	0.06	0.06	-0.07	0.18	0.371
		Missing	7939 (4.51%)											
Social	Body image	About right		89299					Reference				

	Too thin		23887	0.06	0.03	0.00	0.13	0.057	0.06	0.04	-0.02	0.14	0.121
	Too fat		63416	0.11	0.03	0.06	0.16	4.45E-05	0.11	0.03	0.06	0.17	0.0001
	Missing	12110 (6.86%)											
Lived away	No		147446						Reference				
	Yes		29157	0.03	0.03	-0.03	0.09	0.280	0.06	0.03	-0.01	0.13	0.091
	Missing	14641 (8.29%)											
Family practical support	Yes		134582						Reference				
	Ambivalent		12537	0.06	0.04	-0.01	0.14	0.086	0.05	0.05	-0.05	0.14	0.325
	No		29483	0.06	0.04	-0.01	0.14	0.083	0.03	0.04	-0.05	0.10	0.466
	Missing	7015 (3.97%)											
Friends support	Yes		115511						Reference				
	Ambivalent		19310	0.07	0.03	0.01	0.14	0.030	0.06	0.04	-0.03	0.14	0.179
	No		41782	0.10	0.03	0.03	0.16	0.004	0.06	0.03	0.00	0.13	0.057
	Missing	1189 (0.67%)											
Bullying victimisation	No		120043						Reference				
	Less than weekly		42011	0.06	0.03	0.01	0.11	0.019	0.13	0.03	0.08	0.19	2.19E-06
	At least weekly		14550	0.09	0.05	0.00	0.18	0.062	0.17	0.05	0.07	0.28	0.001
	Missing	4719 (2.67%)											
Bullied others	No		151803						Reference				
	Less than weekly		21196	0.01	0.04	-0.06	0.08	0.744	0.05	0.04	-0.03	0.14	0.198
	At least weekly		3604	0.00	0.10	-0.19	0.19	0.997	0.02	0.10	-0.18	0.22	0.848
	Missing	5991 (3.39%)											
Academic pressure	No		85775						Reference				
	Yes		90828	0.11	0.03	0.06	0.17	1.88E-05	0.14	0.03	0.09	0.20	1.39E-06
	Missing	497 (0.28%)											
School support	Yes		114181						Reference				
	Ambivalent		39418	0.05	0.03	-0.01	0.11	0.082	0.04	0.03	-0.02	0.10	0.164

	No		23004	0.07	0.04	0.00	0.15	0.058	0.05	0.04	-0.03	0.14	0.199
	Missing	2624 (1.49%)											
Teachers care	Yes		97526						Reference				
	Ambivalent		49044	0.08	0.02	0.04	0.13	1.00E-04	0.07	0.03	0.01	0.14	0.030
	No		30034	0.11	0.04	0.02	0.19	0.012	0.10	0.05	0.00	0.19	0.042
	Missing	1162 (0.28%)											
Family Affluence Scale	Highest		63210						Reference				
	Middle		65695	0.03	0.03	-0.03	0.09	0.300	0.03	0.03	-0.04	0.10	0.377
	Lowest		47698	0.06	0.04	-0.01	0.13	0.079	0.06	0.04	-0.03	0.14	0.180
	Missing	3531 (2.01%)											

Note: “Teachers care” and “Friends support” denote perceived teacher care and perceived friend support scales. Sub-categories (e.g., “Yes”, “Ambivalent”) represent specific response levels differing from the reference group.

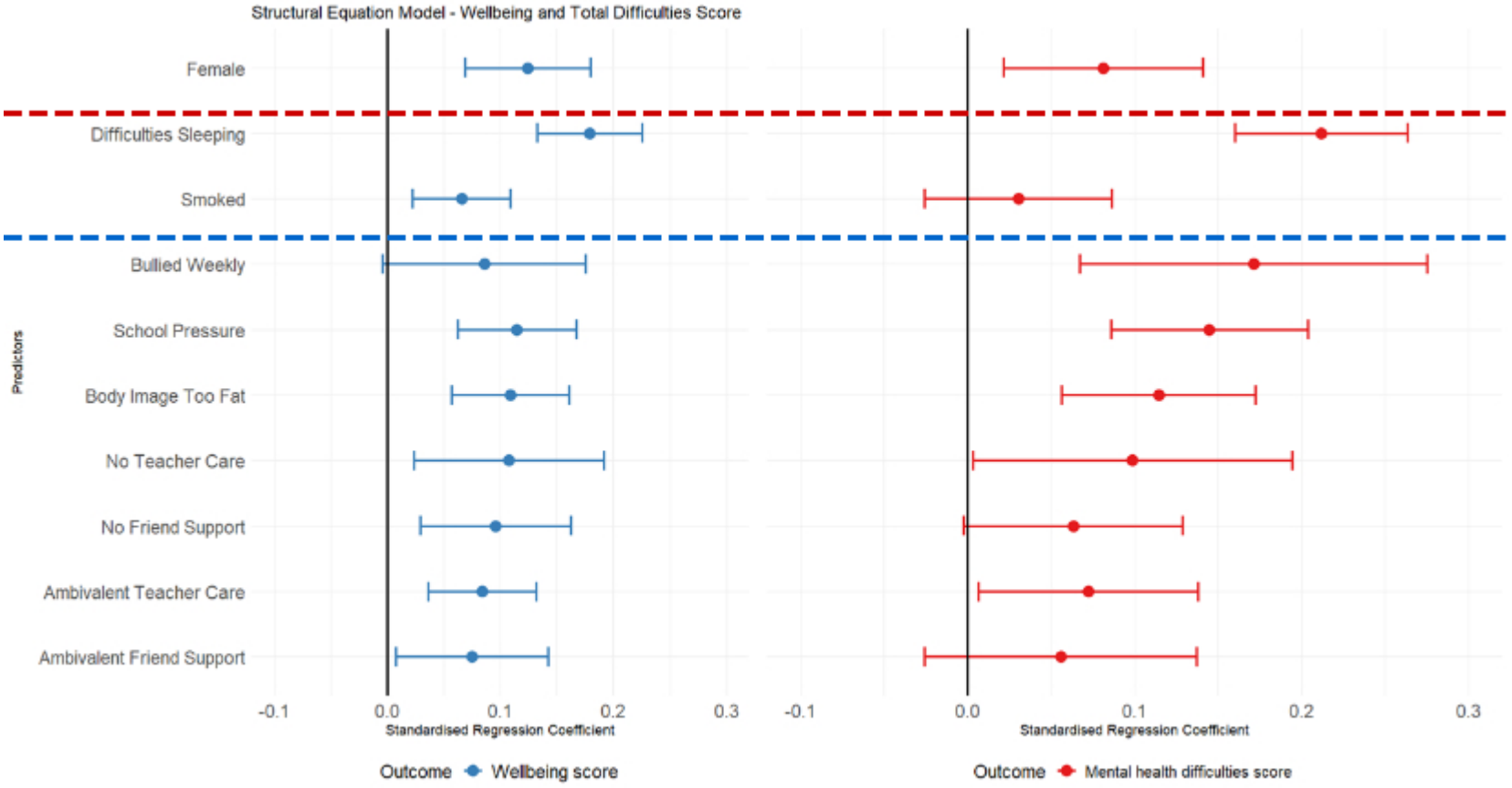

Figure 1. Estimated standardised regression coefficients and their 95% confidence intervals from a SEM (multiple imputed sample, N=176,603) examining associations between explanatory variables and two outcomes: wellbeing (WB, measured using the SWEMWBS scale, blue) and mental health difficulties (MH, measured using the SDQ Total Difficulties score, red). “Teachers care” and “Friends support” denote perceived teacher care and perceived friend

support scales. Sub-categories (e.g., “Yes”, “Ambivalent”) represent specific response levels differing from the reference group. Dotted horizontal lines indicate the boundaries between the three predictor domains: Demographic, Behavioural, and Social factors.

Supplementary Material

S1. Explanatory variables

S1.1. Demographic variables

Age

Age was derived from survey responses on birth month and year. Both the birth date and the survey date were converted into the total number of months elapsed since year zero. The difference between these values was divided by 12 to estimate age in years. Participants were then grouped into two-year categories: 11–12, 13–14, and 15–16 years. Children with calculated ages below 11 years (n = 141) or above 16 years (n = 173) were excluded. The 11–12 years group served as the reference category.

Gender

In 2019 and 2021, when asked about their gender, children were able to answer 'Male', 'Female' or 'Neither word describes me'. The last category was interpreted here as 'Non-binary'. Male was chosen as the reference group.

Ethnicity

Ethnicity categories have been consolidated for analysis purposes. The original labels include White British, White Irish, White - Gypsy/traveller, White Other, Mixed or multiple ethnic group, Pakistani, Indian, Bangladeshi, Chinese, African, Caribbean or Black, Arab, Other, White Roma, I do not want to answer, and NS (Not Specified). These labels have been grouped into broader categories: "White" (including White British, White Irish, White - Gypsy/traveller, White Other, and White Roma), "Asian" (including Pakistani, Indian, Bangladeshi, and Chinese), "Black/Other" (including African, Caribbean or Black, Arab, and Other), and "PNTS" (Prefer Not to Say) (including I do not want to answer and NS). "White" was chosen as the reference category.

Year of assessment

Year of completion of survey (i.e., 2019 or 2021) was included. 2019 was used as the reference group in analyses.

S1.2 Behavioural variables

Smoking

Children were asked how often they smoked cigarettes on a 4-point scale. These responses were simplified into a binary variable: “Every day” or “At least once a week” was classed as “Yes”, while “Less than once a week” or “I do not smoke” was classed as “No”. “No” was used as the reference group.

Vaping

Vaping was assessed with the following question: “Have you ever tried electronic cigarettes? Responses were categorised into "I have never tried e-cigarettes", "I have tried e-cigarettes once", "I have tried e-cigarettes more than once". "I have never tried e-cigarettes" was used as the reference group.

Alcohol consumption

Children were asked how often they drank beer, wine, spirits, cider, alcopops or other alcohol. Responses to these six questions were aggregated to create a single variable for frequency of alcohol consumption. The categories for this variable were simplified from a 5-point scale to “Never”, “Less than weekly” and “Weekly or more”. “Never” was used as the reference group.

Energy drink consumption

How many times a week do you usually drink energy drinks? “Never”, “Less than once a week”, or “At least once a week”. “Never” was used as the reference group.

Physical activity

Children were asked to recount the number of days out of the last seven on which they had been physically active for at least 60 minutes. Their responses were simplified from an 8-point scale ranging from 0 days to 7 days into “Inactive” (0 days), “Less active” (1-3 days) and “More active” (4-7 days). “More active” was used as the reference group.

Sedentary weekdays

Children were asked about their sedentary behaviour with the following question: How many hours a day on weekdays do you usually spend time sitting in your free time? Responses were grouped into “None”, “1-3 hours”, “4-7 hours”, or “7 or more hours”. “None” was used as the reference group.

Sleep difficulty

Children were asked how often they had difficulty sleeping in the last six months. Their responses were simplified from a 5-point frequency scale into a binary variable in which individuals reporting sleeping difficulty every week or more frequently were classed as ‘Yes’, while those who experienced sleeping difficulty monthly or less frequently were classed as ‘No’. “No” was used as the reference group.

Bedtime routine

Children were asked about their bedtime routine with the following question: When do you usually go to bed if you have to go to school the next morning? Responses were grouped into “Before 10pm”, “10pm to midnight”, “Midnight to 2am”, or “2am or after”. “Before 10pm” was used as the reference group.

S1.3. Social variables

Body image

Children were asked how they considered their own body size. Their responses were simplified from a 5-point scale ranging from 'Much too thin' to 'Much too fat' into a three-category variable comprising 'Too thin', 'About right' and 'Too fat'. "About right" was used as the reference group.

Lived away

Individuals who have lived away from their primary residence include those who have stayed with grandparents, aunts or uncles, siblings, other family members, in foster care, in a different residence, independently, or in other unspecified situations. Categories were combined into children who lived away from home were coded as 1, and children who didn't live away from home were coded as 0. Children who didn't lived away from home was used as the reference group.

Family support and support from friends

Children were asked whether their family really tried to help them. Their responses were simplified from 7-point scales ('Very strongly disagree' to 'Very strongly agree') into 'No' (1-3), 'Ambivalent' (4) and 'Yes' (5-7). Their perceived ability to count on their friends was treated similarly. "Yes" was used as the reference group.

Bullying victimisation

Children were asked about bullying victimisation with the following question. How often have you been bullied at school in the past couple of months? Responses were "None" (coded as 0, "Less than weekly" (coded as 1), and "At least weekly (coded as 2)". "None" was used as the reference group.

Bullying others

Children were asked how often they had enacted or experienced bullying in the last two months. Responses to each of these questions were simplified into "Never", "Less than weekly" and "At least weekly". "Never" was used as the reference group.

Academic pressure was assessed using the following item: “How pressured do you feel by the schoolwork you have to do?” Response options were “Not at all,” “A little,” “Some,” and “A lot.” For analysis, we dichotomised the variable to capture meaningful differences in perceived academic strain. Responses of “Not at all” and “A little” were coded as 0 (low pressure), and responses of “Some” and “A lot” were coded as 1 (high pressure). Low pressure was used as the reference group.

School support and teachers caring

Children were asked whether they felt their teachers cared about them and whether there was support for pupils who were unhappy or not coping. Their responses were simplified from 5-point scales (“Strongly disagree” to “Strongly agree”) into 2No” (1-2), ‘Ambivalent’ (3) and “Yes” (4-5). “Yes” was used as the reference group.

Family Affluence Scale (FAS)

The Family Affluence Scale was used as a measure of socioeconomic status[1]. The scale comprises six questions about bedroom-sharing, domestic bathroom count, holidaymaking and computer, dishwasher and car ownership. Given significant changes in the pattern of holidaymaking in 2021 due to the COVID-19 pandemic, this question was dropped from the scale and a 5-item scale was used in all years. Scores were presented as tertiles “Lowest”, “Middle”, or “Highest”. “Highest” was used as the reference group.

S2. Outcomes

S2.1. Strengths and Difficulties Questionnaire (SDQ)

SDQ’s validation is against the Rutter parents’ and teachers’ scale [2], a screening tool for behavioural problems, which was designed to assess changes in “disturbed behaviour” over time (Elander & Rutter, 1996).SDQ is particularly useful in screening for neurodivergence such as attention deficit hyperactivity disorder (sensitivity 0.91, specificity 0.90) and autism spectrum disorder (sensitivity

0.79, specificity 0.93) [4]. Concurrent criterion validity was assessed insofar as it was found to be able to distinguish between paediatric dental and psychiatric populations [2].

Each is assessed by asking the child to respond, “Not true”, “Somewhat true” or “Certainly true” to five statements in each scale. For the four ‘problems’ scales, statements about undesirable traits, such as “I worry a lot” (emotional problems) are scored as “Certainly true” = 2, “Somewhat true” = 1 and “Not true” = 0. Statements about desirable traits, such as “Other people my age generally like me” (peer problems), are scored in reverse, so “Certainly true” = 0, “Somewhat true” = 1 and “Not true” = 2.

S2.2. Short Warwick-Edinburgh Mental Wellbeing Scale (SWEMWBS)

A synthesis of studies using WEMWBS indicates sensitivity to change in wellbeing[5] (as summarised in Warwick guidance). SWEMWBS has also been found to be more precise than the original due to its scaling properties [6]. For SWEMWBS specifically, national-level analyses and adolescent psychometric studies support reliability, validity, and criterion correlations (e.g., with GHQ-12, happiness/life-satisfaction measures[7]. Validation spans general population, adolescent, and clinical samples (including moderate correlations with PHQ-9/GAD-7 and evidence of sensitivity to change[7,8].

Table S1. Association between explanatory variables and non-availability of outcome data for the multiple imputed sample (N=176,603)

Domain	Variables	Estimate	Std. Error	P value
Demographic	2019	Reference		
	2021	-0.06	0.02	0.006
	11-12 years	Reference		
	13-14 years	-0.49	0.03	<0.001
	15-16 years	-0.84	0.04	<0.001
	Male	Reference		
	Female	0.08	0.02	<0.01
	Non-binary	0.12	0.08	0.163
	White	Reference		
	Asian	0.19	0.06	<0.01
	Black and Other	0.18	0.04	<0.001
	Ethnicity PNTS	1.29	0.07	<0.001
Behavioural	Smoking - No	Reference		
	Smoking – Yes	0.39	0.07	<0.001
	Vaping Never	Reference		
	Vaping Once	-0.03	0.04	0.543
	Vaping More than once	-0.06	0.05	0.189
	Alcohol Never	Reference		
	Alcohol Up to 1 drink	-0.13	0.03	<0.001
	Alcohol 2-3 drinks	-0.22	0.04	<0.001
	Alcohol 4+ drinks	-0.17	0.05	<0.01
	Energy drinks rarely or never	Reference		
	Energy drinks daily or more	-0.25	0.06	<0.001
	Energy drinks weekly or more	-0.32	0.06	<0.001
	Physically more active	Reference		
	Physically less active	0.06	0.06	0.292
	Physically inactive	0.06	0.06	0.262
	Sleep difficulties - No	Reference		
	Sleep difficulties - Yes	0.03	0.02	0.161
	Bedtime before 10pm	Reference		
	Bedtime 10pm to 12am	-0.05	0.03	0.084
	Bedtime 12am to 2am	0.01	0.05	0.761
	Bedtime 2am or after	0.06	0.06	0.321
	Body image - About right	Reference		
	Body image - Too thin	0.08	0.03	<0.05
	Body image - Too fat	0.04	0.03	0.164
	Lived away - No	Reference		
	Lived away - Yes	0.16	0.03	<0.001
	Family practical support - Yes	Reference		
	Family practical support - Ambivalent	-0.11	0.05	<0.05
	Family practical support - No	-0.03	0.03	0.395
	Friends support - Yes	Reference		

Social	Friends support - Ambivalent	0.13	0.04	<0.01
	Friends support - No	0.19	0.03	<0.001
	Been bullied - No	Reference		
	Been bullied - Less than weekly	0.15	0.03	<0.001
	Been bullied – At least weekly	0.17	0.04	<0.001
	Bullied others - No	Reference		
	Bullied others - Less than weekly	0.15	0.03	<0.001
	Bullied others - At least weekly	0.26	0.08	<0.01
	Academic pressure – Low	Reference		
	Academic pressure - High	0.00	0.02	0.884
	School support - Yes	Reference		
	School support - Ambivalent	0.11	0.03	<0.001
	School support - No	0.00	0.04	0.902
	Teachers care - Yes	Reference		
	Teachers care - Ambivalent	0.14	0.03	<0.001
	Teachers care - No	0.23	0.04	<0.001
	Family Affluence Scale - Highest	Reference		
	Family Affluence Scale - Middle	-0.12	0.03	<0.001
	Family Affluence Scale - Lowest	-0.21	0.03	<0.001

Note: “Teachers care” and “Friends support” denote perceived teacher care and perceived friend support scales. Sub-categories (e.g., “Yes”, “Ambivalent”) represent specific response levels differing from the reference group.

S3. Correlation between explanatory and outcome variables

A small number of variables exhibited moderate correlations, indicating a potential need for further examination or adjustment (Table S2). Aged 15 or 16 years was moderately positively associated with drinking 4 or more alcohol drinks (rho=0.32). Vaping multiple times was moderately positively associated with smoking (rho=0.36). Drinking 4 or more alcohol drinks was moderately positively associated with vaping multiple times (rho=0.46). Lack of family practical support was moderately positively associated with perception of lack of support from friends (rho=0.34). Perception of not receiving any support in school was moderately positively associated with perception of teachers not caring about pupil's academic achievements or wellbeing (rho=0.34). The latent outcome variables SWEMWBS and SDQTD were strongly negatively associated (r=-0.61), indicating that as MH difficulties worsen, WB declines, and vice versa.

Table S2. Correlation between explanatory and outcome variables

		Demographic							
		Age – 13–1	Age – 15–1	Gender – F	Gender – N	Ethnicity –	Ethnicity –	Ethnicity	Year –
	Age – 13–14 years	1.00							
	Age – 15–16 years	-0.51	1.00						
	Gender – Female	-0.01	0.01	1.00					
Demographic	Gender – Non-binary	0.00	0.01	-0.13	1.00				
	Ethnicity – White	0.00	0.02	0.01	-0.02	1.00			
	Ethnicity – Asian	0.00	0.00	0.00	0.00	-0.50	1.00		
	Ethnicity – Black and Other	0.00	-0.01	-0.01	0.02	-0.80	-0.04	1.00	
	Year – 2021	0.02	0.01	-0.06	0.06	-0.01	0.00	0.01	1.00
	Smoking – Yes	-0.02	0.12	0.02	0.05	-0.01	0.01	0.00	-0.01
	Vaping – Once	0.02	0.10	-0.01	0.00	0.01	-0.02	0.00	-0.03
	Vaping – More than once	-0.02	0.24	0.04	0.03	0.02	-0.02	0.00	0.01
	Alcohol – Up to 1 drink	0.09	-0.01	-0.04	0.02	0.06	-0.05	-0.03	0.03
	Alcohol – 2–3 drinks	0.03	0.18	0.03	0.01	0.06	-0.05	-0.03	0.00
	Alcohol – 4+ drinks	-0.08	0.32	0.06	0.01	0.04	-0.03	-0.03	-0.02
	Drug use – Less than monthly	0.00	0.03	0.00	0.01	-0.02	0.01	0.01	0.00
	Drug use – Monthly or more	0.00	0.03	-0.03	0.09	-0.05	0.05	0.02	0.00
	Energy drinks – Daily or more	0.01	0.03	-0.01	0.05	-0.01	0.00	0.01	0.01
Behavioural	Energy drinks – Weekly or more	0.03	0.03	-0.05	0.03	0.01	-0.02	0.00	0.03
	Physical activity – Inactive	-0.01	0.09	0.03	0.06	-0.02	0.02	0.01	0.00
	Physical activity – Less active	0.02	0.09	0.12	0.03	-0.01	0.02	0.00	-0.02
	Sedentary – 0–3 hours	-0.05	-0.09	0.04	-0.05	0.01	0.00	-0.02	-0.06
	Sedentary – 4–6 hours	0.04	0.07	-0.01	0.00	0.01	-0.01	0.00	0.04
	Sedentary – =7 hours	0.02	0.04	-0.03	0.07	-0.02	0.00	0.02	0.03
	Sleep difficulty – Yes	0.00	0.04	0.09	0.10	0.00	-0.02	0.00	0.05
	Bedtime – Between 10pm and 12am	0.09	0.17	0.01	-0.03	0.02	0.00	-0.01	0.04
	Bedtime – Between 12am and 2am	0.02	0.11	0.00	0.04	0.00	-0.01	0.01	0.05
	Bedtime – 2am or after	0.02	0.05	-0.01	0.11	-0.01	0.01	0.01	0.03
	Body image – Too thin	0.00	0.04	-0.10	0.01	-0.02	0.01	0.01	0.02
	Body image – Too fat	0.03	0.07	0.13	0.08	-0.01	0.01	0.00	0.00
	Living arrangement – One parent	0.01	0.04	0.02	0.03	0.02	-0.06	0.02	-0.02
	Living arrangement – Relative caregiver	0.00	0.01	0.00	0.00	0.00	-0.01	0.01	-0.01
	Living arrangement – In care (Local autho	0.00	0.00	-0.01	0.02	-0.01	0.00	0.00	0.00
	Living arrangement – Parent elsewhere	0.00	0.01	-0.01	0.04	-0.03	0.03	0.02	0.00
	Lived away – Yes	0.00	0.02	-0.04	0.03	-0.08	0.06	0.05	0.00
	Family practical support – Ambivalent	0.02	0.06	0.03	0.05	-0.02	0.01	0.02	0.03
	Family practical support – No	0.01	0.03	0.06	0.08	-0.03	0.02	0.02	0.02
	Friends support – Ambivalent	0.01	0.03	-0.03	0.02	-0.01	0.00	0.01	0.03
Social	Friends support – No	0.00	0.01	0.00	0.04	-0.02	0.01	0.02	0.00
	Been bullied – Less than weekly	0.01	-0.04	0.06	0.03	0.01	-0.02	0.00	-0.02
	Been bullied – At least weekly	0.01	-0.02	-0.01	0.10	0.00	-0.01	0.00	-0.01
	Bullied others – Less than weekly	0.02	0.00	-0.07	0.00	-0.01	0.00	0.01	0.00
	Bullied others – At least weekly	0.01	0.02	-0.04	0.05	-0.03	0.02	0.01	0.01
	Academic pressure – Yes	0.01	0.21	0.13	0.07	0.01	0.00	0.00	0.01
	School support – Ambivalent	0.04	0.07	0.02	0.01	-0.01	0.01	0.01	0.04
	School support – No	0.02	0.13	0.06	0.10	-0.01	0.00	0.01	0.02
	Teachers care – Ambivalent	0.05	0.03	0.04	0.02	0.00	-0.01	0.01	0.02
	Teachers care – No	0.06	0.07	0.04	0.07	-0.01	0.00	0.01	0.00
	Family Affluence Scale – Lowest	-0.01	0.00	0.01	0.02	-0.06	0.02	0.06	-0.02
	Family Affluence Scale – Middle	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	-0.06
Outcomes	Wellbeing – SWEMWBS	0.02	0.10	0.19	0.14	0.00	-0.01	0.00	0.05
	Mental health – SDQTD	0.03	0.10	0.14	0.16	0.02	-0.04	-0.01	0.07

		Behavioural																		
		Smoking –	Vaping – C	Vaping – N	Alcohol – U	Alcohol – 2	Alcohol – 4	Drug use –	Drug use –	Energy dri	Energy dri	Physical ac	Physical ac	Sedentary	Sedentary	Sedentary	Sleep diffic	Bedtime –	Bedtime –	Bedtime –
	Smoking – Yes	1.00																		
	Vaping – Once	-0.01	1.00																	
	Vaping – More than once	0.36	-0.11	1.00																
	Alcohol – Up to 1 drink	-0.04	0.06	-0.05	1.00															
	Alcohol – 2–3 drinks	0.02	0.13	0.14	-0.18	1.00														
	Alcohol – 4+ drinks	0.29	0.09	0.46	-0.17	-0.13	1.00													
	Drug use – Less than monthly	0.17	0.00	0.11	-0.01	0.01	0.10	1.00												
	Drug use – Monthly or more	0.26	0.00	0.11	-0.02	-0.01	0.12	0.00	1.00											
	Energy drinks – Daily or more	0.20	0.03	0.17	0.00	0.04	0.13	0.07	0.11	1.00										
Behavioural	Energy drinks – Weekly or more	0.11	0.08	0.19	0.04	0.09	0.12	0.04	0.02	-0.07	1.00									
	Physical activity – Inactive	0.07	0.01	0.07	-0.01	0.02	0.06	0.01	0.06	0.05	0.01	1.00								
	Physical activity – Less active	0.02	0.02	0.05	0.01	0.03	0.04	0.01	-0.02	0.00	0.00	-0.16	1.00							
	Sedentary – 0–3 hours	-0.04	-0.04	-0.09	-0.05	-0.05	-0.07	-0.01	-0.02	-0.05	-0.06	-0.12	-0.17	1.00						
	Sedentary – 4–6 hours	-0.01	0.02	0.03	0.04	0.04	0.02	-0.01	-0.02	-0.04	0.01	-0.02	0.09	-0.73	1.00					
	Sedentary – =7 hours	0.06	0.02	0.08	0.02	0.02	0.06	0.02	0.04	0.11	0.06	0.19	0.11	-0.37	-0.35	1.00				
	Sleep difficulty – Yes	0.08	0.05	0.13	0.04	0.07	0.10	0.03	0.03	0.07	0.09	0.08	0.09	-0.13	0.03	0.13	1.00			
	Bedtime – Between 10pm and 12am	-0.01	0.07	0.06	0.06	0.10	0.08	-0.01	-0.03	-0.04	0.03	-0.01	0.04	-0.09	0.11	-0.01	-0.02	1.00		
	Bedtime – Between 12am and 2am	0.07	0.05	0.14	0.02	0.08	0.12	0.02	0.01	0.06	0.11	0.06	0.05	-0.12	0.03	0.13	0.15	-0.32	1.00	
	Bedtime – 2am or after	0.15	0.04	0.15	0.01	0.04	0.12	0.08	0.12	0.19	0.09	0.08	0.03	-0.10	-0.04	0.18	0.17	-0.21	-0.07	1.00
	Body image – Too thin	0.01	0.02	0.02	0.02	0.01	0.01	0.00	0.01	0.01	0.02	0.03	0.00	-0.04	0.01	0.04	0.06	0.01	0.02	0.02
	Body image – Too fat	0.06	0.05	0.10	0.04	0.07	0.09	0.02	0.02	0.04	0.05	0.08	0.14	-0.11	0.05	0.09	0.20	0.04	0.08	0.09
	Living arrangement – One parent	0.07	0.06	0.11	0.01	0.04	0.07	0.01	0.00	0.05	0.07	0.05	0.06	-0.07	0.02	0.07	0.09	0.01	0.06	0.06
	Living arrangement – Relative caregiver	0.04	0.02	0.03	-0.01	0.00	0.01	0.01	0.01	0.02	0.03	0.01	0.01	-0.02	-0.01	0.03	0.02	-0.01	0.01	0.02
	Living arrangement – In care (Local autho	0.04	0.01	0.03	-0.01	0.00	0.00	0.01	0.04	0.03	0.00	0.01	0.00	0.00	-0.01	0.02	0.01	-0.03	-0.01	0.02
	Living arrangement – Parent elsewhere	0.07	0.00	0.03	-0.01	0.00	0.04	0.01	0.16	0.04	0.01	0.03	-0.01	-0.01	-0.01	0.01	0.01	-0.01	-0.01	0.05
	Lived away – Yes	0.12	0.05	0.12	0.01	0.03	0.08	0.05	0.07	0.09	0.08	0.03	0.01	-0.04	-0.01	0.07	0.10	-0.02	0.05	0.09
	Family practical support – Ambivalent	0.04	0.04	0.08	0.01	0.05	0.06	0.01	0.00	0.02	0.05	0.04	0.05	-0.07	0.02	0.06	0.11	0.02	0.07	0.06
	Family practical support – No	0.09	0.02	0.09	0.00	0.03	0.07	0.03	0.06	0.07	0.05	0.06	0.04	-0.04	-0.01	0.07	0.11	-0.02	0.05	0.10
	Friends support – Ambivalent	0.01	0.02	0.02	0.02	0.02	0.01	0.00	-0.01	0.00	0.02	0.02	0.03	-0.04	0.02	0.04	0.07	0.01	0.03	0.02
Social	Friends support – No	0.04	0.02	0.04	0.00	0.01	0.02	0.01	0.04	0.03	0.02	0.05	0.03	-0.03	-0.02	0.06	0.08	-0.02	0.03	0.06
	Been bullied – Less than weekly	0.01	0.01	0.01	0.04	0.01	-0.02	0.01	-0.01	0.01	0.02	0.01	0.03	-0.02	0.00	0.03	0.11	-0.03	0.02	0.02
	Been bullied – At least weekly	0.07	0.03	0.05	0.02	0.02	0.03	0.03	0.08	0.07	0.04	0.04	0.02	-0.05	-0.01	0.08	0.12	-0.04	0.02	0.10
	Bullied others – Less than weekly	0.06	0.06	0.11	0.05	0.05	0.06	0.04	0.01	0.06	0.08	0.01	0.02	-0.06	0.01	0.06	0.07	0.02	0.05	0.05
	Bullied others – At least weekly	0.15	0.01	0.11	0.00	0.02	0.08	0.05	0.20	0.11	0.04	0.04	0.00	-0.04	-0.01	0.06	0.05	-0.02	0.03	0.11
	Academic pressure – Yes	0.06	0.06	0.12	0.04	0.11	0.13	0.02	0.02	0.04	0.03	0.07	0.09	-0.12	0.07	0.08	0.23	0.09	0.10	0.09
	School support – Ambivalent	0.02	0.04	0.06	0.04	0.05	0.06	0.01	-0.01	0.01	0.05	0.01	0.04	-0.05	0.03	0.04	0.08	0.06	0.05	0.04
	School support – No	0.10	0.04	0.13	0.01	0.08	0.13	0.04	0.07	0.07	0.05	0.09	0.04	-0.08	0.02	0.09	0.15	0.02	0.09	0.12
	Teachers care – Ambivalent	0.00	0.04	0.04	0.04	0.04	0.04	0.00	-0.02	0.00	0.03	0.02	0.04	-0.05	0.04	0.03	0.09	0.07	0.04	0.02
	Teachers care – No	0.12	0.05	0.15	0.01	0.07	0.13	0.04	0.07	0.09	0.07	0.08	0.02	-0.07	0.00	0.09	0.13	0.02	0.10	0.13
	Family Affluence Scale – Lowest	0.04	0.03	0.03	-0.02	-0.02	0.00	0.00	0.02	0.04	0.05	0.06	0.07	-0.06	0.00	0.08	0.05	-0.03	0.03	0.05
	Family Affluence Scale – Middle	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.03	-0.02	0.01	0.01	0.00	0.00	0.01	0.00
Outcomes	Wellbeing – SWEMWBS	0.13	0.07	0.18	0.05	0.09	0.14	0.05	0.06	0.10	0.10	0.15	0.16	-0.16	0.03	0.17	0.38	0.02	0.14	0.19
	Mental health – SDQTD	0.17	0.11	0.25	0.08	0.13	0.19	0.06	0.06	0.15	0.16	0.14	0.14	-0.20	0.04	0.22	0.45	0.03	0.18	0.22

		Social																							
		Body imag	Body imag	Living arra	Living arra	Living arra	Living arra	Lived awa	Family pra	Family pra	Friends su	Friends su	Been bulli	Been bulli	Bullied oth	Bullied oth	Academic	School sup	School sup	Teachers c	Teachers c	Family Affl	Family Affl	Wellbeing	Mental health – SDQTD
	Body image – Too thin	1.00																							
	Body image – Too fat	-0.28	1.00																						
	Living arrangement – One parent	0.00	0.08	1.00																					
	Living arrangement – Relative caregiver	0.00	0.02	-0.07	1.00																				
	Living arrangement – In care (Local autho	0.00	0.00	-0.04	-0.01	1.00																			
	Living arrangement – Parent elsewhere	0.00	0.01	-0.02	0.00	0.00	1.00																		
	Lived away – Yes	0.03	0.05	0.11	0.18	0.14	0.06	1.00																	
	Family practical support – Ambivalent	0.02	0.09	0.07	0.02	0.01	0.00	0.06	1.00																
	Family practical support – No	0.01	0.08	0.05	0.02	0.03	0.03	0.09	-0.12	1.00															
	Friends support – Ambivalent	0.02	0.05	0.02	0.00	0.00	0.00	0.03	0.07	0.01	1.00														
Social	Friends support – No	0.02	0.07	0.04	0.02	0.01	0.02	0.05	0.04	0.34	-0.19	1.00													
	Been bullied – Less than weekly	0.01	0.11	0.03	0.01	0.01	0.00	0.06	0.04	0.04	0.06	0.06	1.00												
	Been bullied – At least weekly	0.02	0.11	0.05	0.02	0.03	0.03	0.08	0.04	0.08	0.03	0.11	-0.15	1.00											
	Bullied others – Less than weekly	0.03	0.05	0.05	0.02	0.02	0.01	0.09	0.04	0.04	0.03	0.05	0.17	0.07	1.00										
	Bullied others – At least weekly	0.02	0.03	0.02	0.01	0.03	0.08	0.06	0.02	0.06	0.00	0.05	-0.01	0.21	-0.05	1.00									
	Academic pressure – Yes	0.04	0.17	0.04	0.01	-0.01	0.01	0.05	0.10	0.08	0.06	0.05	0.09	0.09	0.04	0.03	1.00								
	School support – Ambivalent	0.02	0.06	0.03	0.00	0.00	0.00	0.03	0.07	0.02	0.06	0.03	0.03	0.02	0.05	0.01	0.11	1.00							
	School support – No	0.02	0.13	0.04	0.01	0.00	0.03	0.06	0.09	0.13	0.04	0.09	0.05	0.12	0.04	0.08	0.18	-0.19	1.00						
	Teachers care – Ambivalent	0.02	0.07	0.03	0.00	0.00	0.00	0.02	0.07	0.01	0.07	0.02	0.03	0.01	0.03	-0.01	0.11	0.19	0.02	1.00					
	Teachers care – No	0.02	0.12	0.05	0.01	0.01	0.02	0.07	0.08	0.12	0.04	0.09	0.04	0.10	0.07	0.09	0.17	0.07	0.34	-0.26	1.00				
	Family Affluence Scale – Lowest	0.00	0.06	0.21	0.03	0.00	0.01	0.05	0.04	0.03	0.02	0.04	0.03	0.04	0.02	0.02	0.00	0.01	0.01	0.00	0.01	1.00			
	Family Affluence Scale – Middle	0.00	0.01	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.01	-0.01	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	-0.01	-0.44	1.00		
Outcomes	Wellbeing – SWEMWBS	0.06	0.27	0.12	0.04	0.02	0.03	0.12	0.17	0.19	0.12	0.18	0.14	0.19	0.09	0.08	0.31	0.14	0.25	0.14	0.25	0.10	0.00	1.00	
	Mental health – SDQTD	0.07	0.31	0.15	0.05	0.04	0.03	0.18	0.18	0.18	0.12	0.17	0.21	0.28	0.17	0.13	0.36	0.14	0.26	0.14	0.27	0.10	0.01	0.61	1.00

S4. Association between explanatory variables *and outcomes – complete case analysis (N=126,538)*

A comparable pattern of results emerged for the explanatory variables in the complete case analysis (Table S3 and Figure S1). Explanatory variable that showed significant associations with both greater MH difficulties and worsening WB were: gender (female) (MH: β=0.09, 95% CI = 0.03 to 0.14, p < 0.001) and (WB (β=0.13, 95% CI = 0.08 to 0.18, p < 0.001); difficulties sleeping (MH: β=0.21, 95% CI = 0.16 to 0.27, p < 0.001) and WB: β=0.18, 95% CI = 0.13 to 0.23, p < 0.001); high academic pressure (MH: β=0.14, 95% CI = 0.09 to 0.20, p < 0.001) and (WB: β=0.12, 95% CI = 0.07 to 0.17, p < 0.001); and negative body image (perceived as overweight) (MH: β=0.11, 95% CI = 0.05 to 0.18, p < 0.001) and (WB: β=0.11, 95% CI = 0.05 to 0.16, p < 0.001); perceiving their teachers do not care about their pupil's wellbeing and academic progress (MH: β=0.09, 95% CI = 0.01 to 0.18, p < 0.05) and (WB: β=0.10, 95% CI = 0.03 to 0.18, p < 0.01); and having mixed or uncertain feelings about whether teachers care for pupils' wellbeing and academic progress (MH: β=0.07, 95% CI = 0.01 to 0.14, p < 0.05) and (WB: β=0.09, 95% CI = 0.03 to 0.15, p < 0.01); experiencing bullying less than weekly (MH: β=0.14, 95% CI = 0.07 to 0.20, p < 0.001) and (WB: β=0.06, 95% CI = 0.00 to 0.12, p < 0.05).

Being less physically active (β=0.07, 95% CI = 0.01 to 0.12, p < 0.05) and lack of support from friends (β=0.09, 95% CI = 0.03 to 0.15, p < 0.01) were associated with lower WB. Being bullied at least weekly (β=0.17, 95% CI = 0.06 to 0.28, p < 0.01) was associated with greater MH difficulties.

Table S3. Estimated standardised regression coefficients from a SEM examining the associations between explanatory variables across the two outcomes (complete case analysis: N=126,538): Wellbeing (measured by the SWEMWBS scale) and mental health (measured by SDQ Total Difficulties score).

			Wellbeing					**SDQ Total Difficulties**				
Domain	Predictor	Category	Estimate	S.E.	95% CI Lower	95% CI Upper	p value	Estimate	S.E.	95% CI Lower	95% CI Upper	p value
Demographic	Age	11-12 years					Reference					
		13-14 years	-0.03	0.03	-0.09	0.03	0.374	-0.02	0.03	-0.09	0.05	0.534
		15-16 years	-0.03	0.04	-0.10	0.05	0.464	-0.05	0.04	-0.13	0.04	0.275
	Gender	Male					Reference					
		Female	0.13	0.03	0.08	0.18	3.24E-07	0.09	0.03	0.03	0.14	0.002
		Non-binary	0.06	0.10	-0.14	0.25	0.572	0.05	0.11	-0.17	0.27	0.638
	Year	2019					Reference					
		2021	0.03	0.02	-0.01	0.08	0.148	0.05	0.03	-0.01	0.10	0.090
	Ethnicity	White					Reference					
		Asian	-0.01	0.07	-0.16	0.13	0.886	-0.03	0.08	-0.20	0.13	0.680
		Black and Other	-0.01	0.05	-0.11	0.08	0.774	-0.02	0.05	-0.13	0.09	0.696
		Prefer not to say	0.01	0.14	-0.28	0.29	0.964	0.00	0.16	-0.31	0.32	0.985
Behavioural	Smoking	No					Reference					
		Yes	0.02	0.08	-0.14	0.18	0.811	0.02	0.09	-0.17	0.20	0.864
	Vaping	Never					Reference					
		Once	0.01	0.04	-0.07	0.10	0.783	0.04	0.05	-0.06	0.13	0.465
		More than once	0.02	0.05	-0.07	0.11	0.594	0.07	0.05	-0.04	0.17	0.205
	Alcohol consumption	Never					Reference					
		Up to 1 drink	0.02	0.03	-0.05	0.08	0.594	0.05	0.04	-0.02	0.12	0.192
		2-3 drinks	0.01	0.04	-0.07	0.09	0.826	0.04	0.05	-0.05	0.14	0.364
		4+ drinks	0.01	0.05	-0.09	0.11	0.872	0.05	0.06	-0.06	0.16	0.396
	Energy drinks consumption	Rarely or never					Reference					
		Weekly or more	0.02	0.04	-0.05	0.09	0.605	0.04	0.09	-0.13	0.21	0.647
		Daily or more	0.02	0.08	-0.13	0.17	0.781	0.05	0.04	-0.03	0.13	0.252

	Physical activity	More active					Reference					
		Less active	0.07	0.03	0.01	0.12	0.012		0.03	0.03	-0.03	0.09	0.327
		Inactive	0.07	0.06	-0.05	0.19	0.264		0.04	0.07	-0.10	0.17	0.598
	Sedentary	0-3 hours						Reference					
		4-6 hours	0.01	0.02	-0.04	0.05	0.808		0.03	0.03	-0.02	0.09	0.243
		>= 7 hours	0.03	0.04	-0.04	0.11	0.395		0.08	0.04	-0.01	0.16	0.070
	Sleep difficulties	No						Reference					
		Yes	0.18	0.03	0.13	0.23	7.59E-12		0.21	0.03	0.16	0.27	4.05E-13
	Bedtime	By 10pm						Reference					
		Between 10pm and midnight	0.03	0.03	-0.03	0.08	0.370		0.04	0.03	-0.02	0.10	0.233
		Between midnight and 2am	0.04	0.05	-0.06	0.13	0.444		0.05	0.05	-0.05	0.16	0.313
		2am or after	0.05	0.07	-0.07	0.18	0.406		0.05	0.07	-0.09	0.20	0.457
Social	Body image	About right						Reference					
		Too thin	0.06	0.04	-0.01	0.14	0.092		0.06	0.04	-0.02	0.14	0.139
		Too fat	0.11	0.03	0.05	0.16	0.0001		0.11	0.03	0.05	0.18	0.0003
	Lived away	No						Reference					
		Yes	0.03	0.03	-0.03	0.10	0.342		0.06	0.04	-0.02	0.13	0.139
	Family practical support	Yes						Reference					
		Ambivalent	0.06	0.05	-0.03	0.16	0.195		0.05	0.06	-0.06	0.16	0.407
		No	0.06	0.04	-0.01	0.13	0.114		0.03	0.04	-0.05	0.11	0.500
	Friends support	Yes						Reference					
		Ambivalent	0.08	0.04	0.00	0.16	0.055		0.06	0.05	-0.03	0.15	0.190
		No	0.09	0.03	0.03	0.15	0.004		0.06	0.04	-0.01	0.13	0.071
	Been bullied	No						Reference					
		Less than weekly	0.06	0.03	0.00	0.12	0.044		0.14	0.03	0.07	0.20	5.54E-05
		At least weekly	0.08	0.05	-0.02	0.18	0.102		0.17	0.06	0.06	0.28	0.002
	Bullied others	No						Reference					

	Less than weekly	0.01	0.04	-0.06	0.09	0.751	0.05	0.04	-0.03	0.14	0.220
	At least weekly	0.00	0.10	-0.19	0.19	0.994	0.02	0.11	-0.19	0.23	0.839
Academic pressure	No					Reference					
	Yes	0.12	0.03	0.07	0.17	5.81E-06	0.14	0.03	0.09	0.20	9.88E-07
School support	Yes					Reference					
	Ambivalent	0.05	0.03	-0.01	0.11	0.101	0.04	0.04	-0.03	0.11	0.235
	No	0.07	0.04	-0.01	0.16	0.075	0.06	0.05	-0.03	0.15	0.222
Teachers care	Yes					Reference					
	Ambivalent	0.09	0.03	0.03	0.15	0.002	0.07	0.03	0.01	0.14	0.027
	No	0.10	0.04	0.03	0.18	0.006	0.09	0.04	0.01	0.18	0.030
Family Affluence Scale	Highest					Reference					
	Middle	0.03	0.03	-0.02	0.09	0.265	0.03	0.03	-0.03	0.09	0.369
	Lowest	0.06	0.03	0.00	0.12	0.052	0.05	0.04	-0.01	0.12	0.121

Note: “Teachers care” and “Friends support” denote perceived teacher care and perceived friend support scales. Sub-categories (e.g., “Yes”, “Ambivalent”) represent specific response levels differing from the reference group.

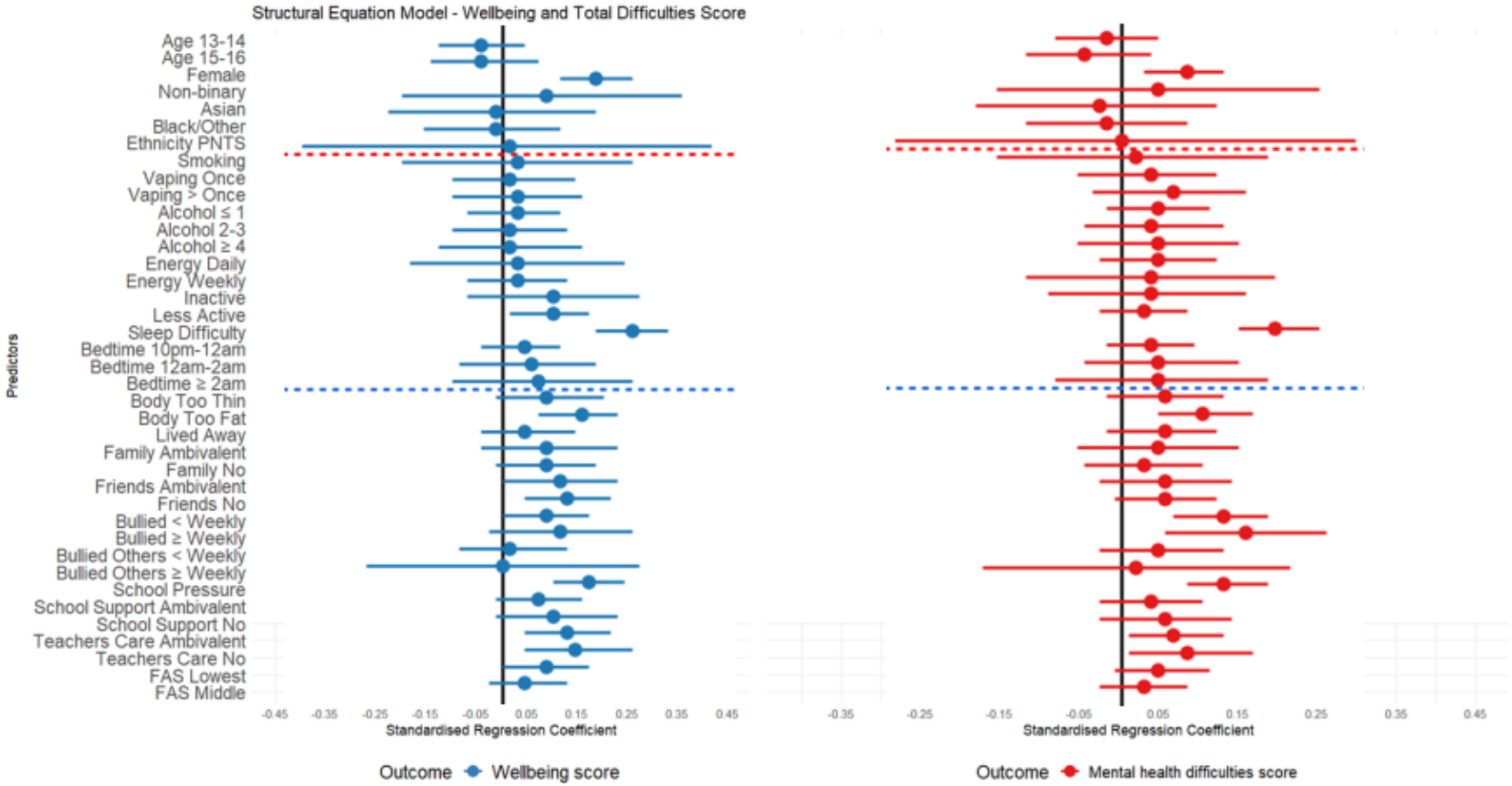
Structural Equation Model - Wellbeing and Total Difficulties Score
Predictors
Age 13-14
Age 15-16
Female
Non-binary
Asian
Black/Other
Ethnicity PNTS
Smoking
Vaping Once
Vaping > Once
Alcohol ≤ 1
Alcohol 2-3
Alcohol ≥ 4
Energy Daily
Energy Weekly
Inactive
Less Active
Sleep Difficulty
Bedtime 10pm-12am
Bedtime 12am-2am
Bedtime ≥ 2am
Body Too Thin
Body Too Fat
Lived Away
Family Ambivalent
Family No
Friends Ambivalent
Friends No
Bullied < Weekly
Bullied ≥ Weekly
Bullied Others < Weekly
Bullied Others ≥ Weekly
School Pressure
School Support Ambivalent
School Support No
Teachers Care Ambivalent
Teachers Care No
FAS Lowest
FAS Middle
-0.45 -0.35 -0.25 -0.15 -0.05 0.05 0.15 0.25 0.35 0.45
Standardised Regression Coefficient
Outcome Wellbeing score
-0.35 -0.25 -0.15 -0.05 0.05 0.15 0.25 0.35 0.45
Standardised Regression Coefficient
Outcome Mental health difficulties score

Figure S1. Estimated standardised regression coefficients and their 95% confidence intervals from a SEM examining the associations between explanatory variables across the two outcomes (complete case analysis: N=126,538): WB (measured by the SWEMWBS scale, shown in blue) and MH (measured by SDQ Total Difficulties score, shown in red). “Teachers care” and “Friends support” denote perceived teacher care and perceived friend support scales. Sub-categories (e.g., “Yes”, “Ambivalent”) represent specific response levels differing from the reference group. Dotted horizontal lines indicate the boundaries between the three predictor domains: Demographic, Behavioural, and Social factors.

S5. Association between explanatory variables *and outcomes – 2019 survey*

A similar pattern of results was identified for the explanatory variables in the 2019 survey (Table S4 and Figure S2). Explanatory variable that showed significant associations with both greater MH difficulties and worsening WB were: difficulties sleeping (MH: β=0.21, 95% CI = 0.14 to 0.29, $p < 0.001$), and (WB: β=0.18, 95% CI = 0.12 to 0.25, $p < 0.001$); high academic pressure (MH: β=0.15, 95% CI = 0.06 to 0.23, $p < 0.01$) and (WB: β=0.11, 95% CI = 0.04 to 0.18, $p < 0.01$); and negative body image (perceived as overweight) (MH: β=0.11, 95% CI = 0.03 to 0.19, $p < 0.01$) and (WB: β=0.11, 95% CI = 0.03 to 0.18, $p < 0.01$).

Gender (female) (β=0.12, 95% CI = 0.04 to 0.19, $p < 0.01$); having mixed or uncertain feelings about whether teachers care for pupils' wellbeing and academic progress (β=0.08, 95% CI = 0.01 to 0.15, $p < 0.05$); perceiving friends do not provide support (β=0.010, 95% CI = 0.00 to 0.20, $p < 0.05$) were associated with lower WB. Experiencing bullying less than weekly (β=0.14, 95% CI = 0.06 to 0.21, $p < 0.001$) and experiencing bullying at least weekly (β=0.18, 95% CI = 0.03 to 0.33, $p < 0.01$) were associated with greater MH difficulties.

Table S4. Estimated standardised regression coefficients from a SEM (2019 cohort, N=87,264) examining the associations of significant explanatory variables across the two outcomes: wellbeing (measured by the SWEMWBS scale) and mental health difficulties (measured by SDQ Total Difficulties score).

			Wellbeing					Mental health				
Domain	Predictor	Category	Estimate	S.E.	95% CI Lower	95% CI Upper	p value	Estimate	S.E.	95% CI Lower	95% CI Upper	p value
Demographic	Age	11-12 years	Reference									
		13-14 years	-0.03	0.04	-0.12	0.06	0.502	-0.02	0.05	-0.11	0.08	0.731
		15-16 years	-0.03	0.06	-0.14	0.07	0.539	-0.04	0.06	-0.17	0.09	0.545
	Gender	Male	Reference									
		Female	0.12	0.04	0.04	0.19	0.002	0.07	0.04	-0.01	0.15	0.093
		Non-binary	0.04	0.20	-0.36	0.43	0.856	0.03	0.21	-0.38	0.44	0.890
	Ethnicity	White	Reference									
		Asian	-0.01	0.10	-0.20	0.18	0.895	-0.03	0.10	-0.23	0.16	0.728
		Black and Other	-0.01	0.08	-0.18	0.15	0.867	-0.02	0.08	-0.17	0.13	0.802
		Prefer not to say	0.02	0.14	-0.27	0.30	0.902	0.01	0.15	-0.29	0.31	0.965
Behavioural	Smoking	No	Reference									
		Yes	0.03	0.12	-0.21	0.27	0.811	0.02	0.13	-0.23	0.27	0.870
	Vaping	Never	Reference									
		Once	0.01	0.06	-0.10	0.12	0.817	0.04	0.07	-0.10	0.18	0.564
		More than once	0.02	0.06	-0.10	0.14	0.726	0.06	0.08	-0.09	0.22	0.413
	Alcohol consumption	Never	Reference									
		Up to 1 drink	0.01	0.04	-0.07	0.09	0.853	0.05	0.05	-0.04	0.13	0.316
		2-3 drinks	0.01	0.06	-0.11	0.12	0.921	0.04	0.06	-0.09	0.16	0.542
		4+ drinks	0.01	0.08	-0.14	0.16	0.912	0.05	0.07	-0.10	0.19	0.534
	Energy drinks consumption	Rarely or never	Reference									
		Weekly or more	0.02	0.05	-0.08	0.11	0.723	0.04	0.05	-0.06	0.15	0.422
		Daily or more	0.03	0.11	-0.19	0.25	0.807	0.04	0.12	-0.19	0.28	0.719
	Physical activity	More active	Reference									
		Less active	0.06	0.03	0.00	0.13	0.063	0.03	0.04	-0.06	0.11	0.544

		Inactive	0.06	0.09	-0.10	0.23	0.460		0.03	0.09	-0.15	0.21	0.742
	Sedentary	0-3 hours						Reference					
		4-6 hours	0.00	0.03	-0.06	0.07	0.885		0.03	0.04	-0.05	0.11	0.420
		>= 7 hours	0.03	0.06	-0.09	0.14	0.626		0.07	0.06	-0.04	0.18	0.189
	Sleep difficulties	No						Reference					
		Yes	0.18	0.03	0.12	0.25	6.62E-10		0.21	0.04	0.14	0.29	4.70E-08
	Bedtime	By 10pm						Reference					
		Between 10pm and midnight	0.02	0.04	-0.05	0.10	0.547		0.04	0.04	-0.05	0.12	0.408
		Between midnight and 2am	0.03	0.06	-0.09	0.16	0.590		0.05	0.07	-0.09	0.19	0.447
		2am or after	0.06	0.10	-0.13	0.24	0.555		0.06	0.10	-0.14	0.25	0.574
Social	Body image	About right						Reference					
		Too thin	0.06	0.04	-0.03	0.15	0.166		0.06	0.06	-0.06	0.18	0.342
		Too fat	0.11	0.04	0.03	0.18	0.004		0.11	0.04	0.03	0.19	0.007
	Lived away	No						Reference					
		Yes	0.03	0.05	-0.06	0.12	0.460		0.06	0.05	-0.03	0.16	0.204
	Family practical support	Yes						Reference					
		Ambivalent	0.07	0.06	-0.06	0.19	0.295		0.05	0.08	-0.11	0.21	0.554
		No	0.06	0.05	-0.04	0.16	0.265		0.02	0.05	-0.08	0.12	0.688
	Friends support	Yes						Reference					
		Ambivalent	0.08	0.05	-0.02	0.18	0.111		0.06	0.06	-0.05	0.17	0.292
		No	0.10	0.05	0.00	0.20	0.047		0.06	0.05	-0.04	0.16	0.229
	Been bullied	No						Reference					
		Less than weekly	0.06	0.03	-0.01	0.13	0.072		0.14	0.04	0.06	0.21	0.0001
		At least weekly	0.09	0.07	-0.04	0.22	0.177		0.18	0.08	0.03	0.33	0.019
	Bullied others	No						Reference					
		Less than weekly	0.01	0.05	-0.10	0.11	0.873		0.05	0.06	-0.06	0.16	0.363
		At least weekly	0.00	0.13	-0.26	0.26	0.989		0.02	0.16	-0.29	0.34	0.876
		No						Reference					

Academic pressure	Yes	0.11	0.03	0.04	0.18	0.002		0.15	0.04	0.06	0.23	<0.01
School support	Yes						Reference					
	Ambivalent	0.05	0.04	-0.03	0.12	0.256		0.04	0.04	-0.04	0.12	0.292
	No	0.07	0.06	-0.04	0.19	0.214		0.06	0.07	-0.07	0.18	0.396
Teachers care	Yes						Reference					
	Ambivalent	0.08	0.04	0.01	0.15	<0 .05		0.07	0.04	-0.01	0.16	0.075
	No	0.10	0.06	-0.01	0.22	0.068		0.10	0.06	-0.02	0.22	0.102
Family Affluence Scale	Highest						Reference					
	Middle	0.04	0.04	-0.04	0.12	0.314		0.03	0.05	-0.06	0.12	0.469
	Lowest	0.07	0.05	-0.02	0.16	0.139		0.06	0.05	-0.04	0.16	0.216

Note: “Teachers care” and “Friends support” denote perceived teacher care and perceived friend support scales. Sub-categories (e.g., “Yes”, “Ambivalent”) represent specific response levels differing from the reference group.

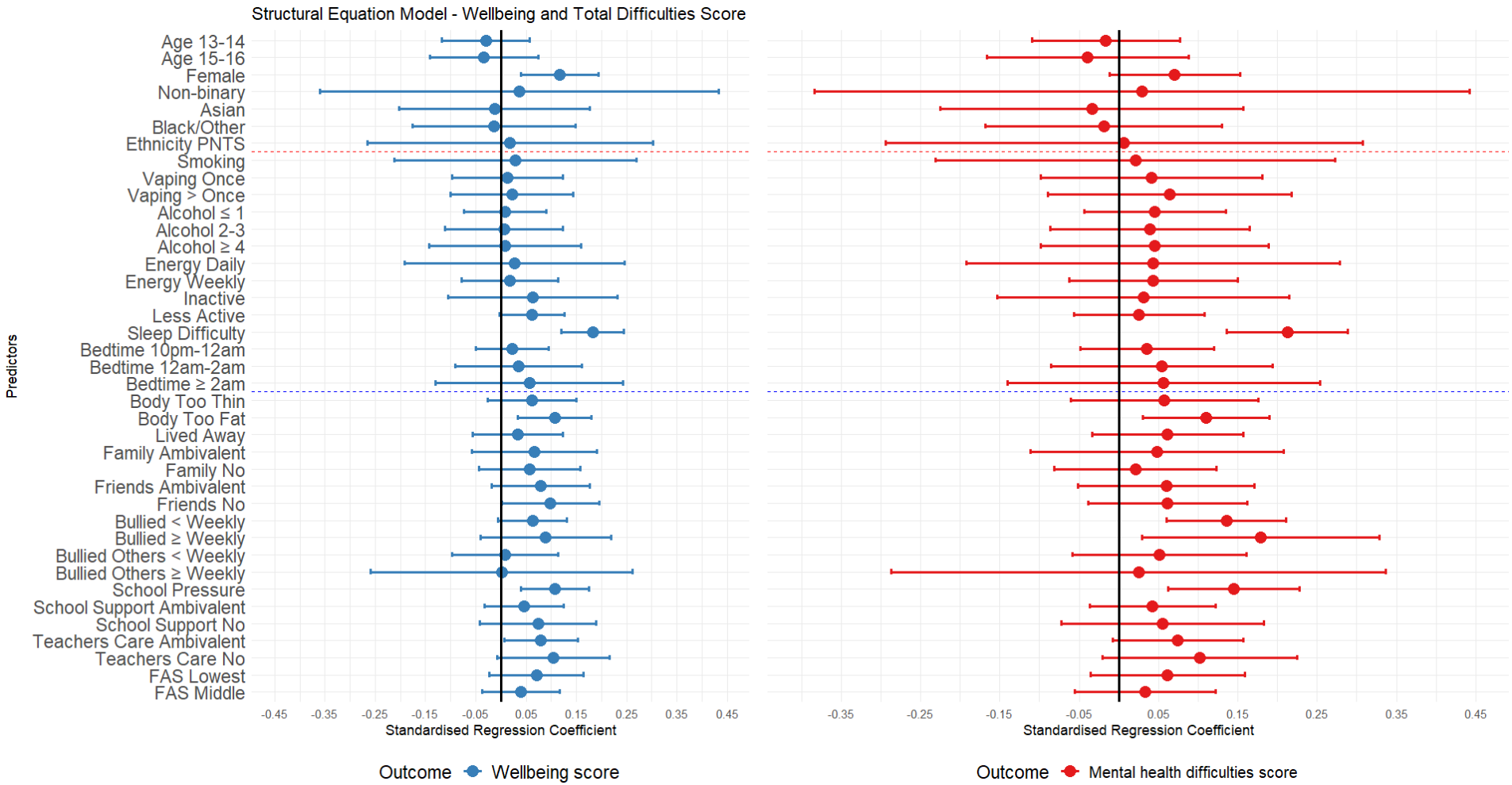

Figure S2. Estimated standardised regression coefficients and their 95% confidence intervals from a SEM examining the associations between explanatory variables across the two outcomes for the 2019 survey (N=87,264): WB (measured by the SWEMWBS scale, shown in blue) and MH (measured by SDQ Total Difficulties score, shown in red. Note: “Teachers care” and “Friends support” denote perceived teacher care and perceived friend support scales.

Sub-categories (e.g., “Yes”, “Ambivalent”) represent specific response levels differing from the reference group. Dotted horizontal lines indicate the boundaries between the three predictor domains: Demographic, Behavioural, and Social factors.

S6. Association between explanatory variables *and outcomes – 2021 survey*

A similar pattern of results was identified for the explanatory variables in the 2021 survey (Table S5 and Figure S3). Explanatory variable that showed significant associations with both greater MH difficulties and worsening WB were: gender (female) (MH: β=0.09, 95% CI = 0.02 to 0.17, $p < 0.05$) and (WB: β=0.13, 95% CI = 0.07 to 0.20, $p < 0.001$); difficulties sleeping (MH: β=0.21, 95% CI = 0.14 to 0.28, $p < 0.001$), and (WB: β=0.17, 95% CI = 0.11 to 0.24, $p < 0.001$); high academic pressure (MH: β=0.15, 95% CI = 0.06 to 0.23, $p < 0.01$) and (WB: β=0.11, 95% CI = 0.06 to 0.17, $p < 0.001$); and negative body image (perceived as overweight) (MH: β=0.12, 95% CI = 0.04 to 0.20, $p < 0.01$) and (WB: β=0.11, 95% CI = 0.04 to 0.18, $p < 0.01$).

Having mixed or uncertain feelings about whether teachers care for pupils' wellbeing and academic progress (β=0.09, 95% CI = 0.02 to 0.16, $p < 0.05$); perceiving their teachers do not care about their pupil's wellbeing and academic progress (β=0.11, 95% CI = 0.01 to 0.21, $p < 0.05$); and perceiving friends do not provide support (β=0.09, 95% CI = 0.01 to 0.17, $p < 0.05$) were associated with lower WB. Experiencing bullying less than weekly (β=0.13, 95% CI = 0.05 to 0.21, $p < 0.01$); and experiencing bullying at least weekly (WB: β=0.17, 95% CI = 0.03 to 0.30, $p < 0.05$) were associated with greater MH difficulties.

Table S5. Estimated standardised regression coefficients from a SEM (2021 cohort, N=89,339) examining the associations of significant explanatory variables across the two outcomes: wellbeing (measured by the SWEMWBS scale) and mental health difficulties (measured by SDQ Total Difficulties score).

			Wellbeing					**Mental health**				
Domain	Predictor	Category	Estimate	S.E.	95% CI Lower	95% CI Upper	p value	Estimate	S.E.	95% CI Lower	95% CI Upper	p value
Demographic	Age	11-12 years					Reference					
		13-14 years	-0.03	0.04	-0.11	0.05	0.474	-0.03	0.05	-0.12	0.06	0.507
		15-16 years	-0.04	0.05	-0.14	0.07	0.501	-0.06	0.05	-0.16	0.05	0.310
	Gender	Male					Reference					
		Female	0.13	0.03	0.07	0.20	9.54E-05	0.09	0.04	0.02	0.17	0.017
		Non-binary	0.08	0.10	-0.12	0.27	0.436	0.07	0.11	-0.14	0.28	0.516
	Ethnicity	White					Reference					
		Asian	-0.01	0.09	-0.19	0.17	0.913	-0.04	0.11	-0.26	0.18	0.731
		Black and Other	-0.02	0.07	-0.15	0.12	0.802	-0.02	0.07	-0.16	0.11	0.723
		Prefer not to say	0.01	0.13	-0.24	0.27	0.919	0.00	0.13	-0.26	0.26	0.982
Behavioural	Smoking	No					Reference					
		Yes	0.03	0.11	-0.20	0.25	0.825	0.01	0.12	-0.24	0.25	0.961
	Vaping	Never					Reference					
		Once	0.01	0.06	-0.11	0.13	0.845	0.03	0.07	-0.11	0.17	0.663
		More than once	0.02	0.05	-0.09	0.13	0.702	0.06	0.07	-0.07	0.20	0.339
	Alcohol consumption	Never					Reference					
		Up to 1 drink	0.02	0.04	-0.07	0.10	0.686	0.05	0.05	-0.05	0.14	0.318
		2-3 drinks	0.01	0.05	-0.09	0.11	0.851	0.04	0.07	-0.09	0.17	0.530
		4+ drinks	0.01	0.07	-0.13	0.14	0.903	0.04	0.08	-0.12	0.20	0.613
	Energy drinks consumption	Rarely or never					Reference					
		Weekly or more	0.02	0.10	-0.17	0.22	0.799	0.04	0.10	-0.16	0.24	0.716
		Daily or more	0.02	0.04	-0.06	0.11	0.611	0.05	0.05	-0.05	0.15	0.341
	Physical activity	More active					Reference					
		Less active	0.07	0.03	0.01	0.13	0.026	0.04	0.04	-0.03	0.10	0.315

		Inactive	0.07	0.08	-0.08	0.23	0.362	0.03	0.08	-0.12	0.19	0.655
	Sedentary	0-3 hours					Reference					
		4-6 hours	0.01	0.03	-0.05	0.07	0.796	0.03	0.04	-0.05	0.11	0.400
		>= 7 hours	0.04	0.05	-0.06	0.13	0.453	0.08	0.06	-0.03	0.19	0.146
	Sleep difficulties	No					Reference					
		Yes	0.17	0.03	0.11	0.24	3.62E-07	0.21	0.03	0.14	0.28	6.62E-10
	Bedtime	By 10pm					Reference					
		Between 10pm and midnight	0.02	0.04	-0.05	0.09	0.653	0.04	0.04	-0.05	0.12	0.424
		Between midnight and 2am	0.04	0.06	-0.07	0.15	0.515	0.06	0.07	-0.08	0.19	0.403
		2am or after	0.06	0.08	-0.09	0.21	0.421	0.06	0.09	-0.12	0.23	0.528
Social	Body image	About right					Reference					
		Too thin	0.06	0.04	-0.02	0.15	0.130	0.07	0.05	-0.03	0.16	0.181
		Too fat	0.11	0.03	0.04	0.18	0.001	0.12	0.04	0.04	0.20	0.001
	Lived away	No					Reference					
		Yes	0.03	0.04	-0.05	0.11	0.430	0.06	0.05	-0.04	0.15	0.245
	Family practical support	Yes					Reference					
		Ambivalent	0.06	0.05	-0.04	0.17	0.244	0.05	0.06	-0.07	0.16	0.427
		No	0.07	0.05	-0.03	0.17	0.171	0.03	0.05	-0.07	0.14	0.524
	Friends support	Yes					Reference					
		Ambivalent	0.07	0.05	-0.02	0.16	0.127	0.05	0.06	-0.06	0.17	0.367
		No	0.09	0.04	0.01	0.17	0.020	0.07	0.04	-0.02	0.15	0.133
	Been bullied	No					Reference					
		Less than weekly	0.06	0.04	-0.01	0.13	0.107	0.13	0.04	0.05	0.21	0.001
		At least weekly	0.08	0.07	-0.05	0.21	0.205	0.17	0.07	0.03	0.30	<0.05
	Bullied others	No					Reference					
		Less than weekly	0.02	0.05	-0.09	0.12	0.769	0.06	0.06	-0.06	0.17	0.348
		At least weekly	0.00	0.13	-0.26	0.26	0.995	0.01	0.13	-0.25	0.28	0.911
	Academic pressure	No					Reference					

	Yes	0.12	0.04	0.05	0.19	0.0001	0.15	0.04	0.06	0.23	0.001
School support	Yes					Reference					
	Ambivalent	0.05	0.04	-0.02	0.13	0.175	0.04	0.04	-0.05	0.12	0.384
	No	0.07	0.06	-0.03	0.18	0.175	0.05	0.06	-0.06	0.17	0.366
Teachers care	Yes					Reference					
	Ambivalent	0.09	0.04	0.02	0.16	0.012	0.07	0.04	-0.01	0.16	0.105
	No	0.11	0.05	0.01	0.21	0.032	0.10	0.06	-0.03	0.22	0.139
Family Affluence Scale	Highest					Reference					
	Middle	0.02	0.04	-0.05	0.10	0.533	0.03	0.04	-0.05	0.11	0.490
	Lowest	0.05	0.04	-0.03	0.14	0.214	0.05	0.05	-0.05	0.15	0.321

Note: “Teachers care” and “Friends support” denote perceived teacher care and perceived friend support scales. Sub-categories (e.g., “Yes”, “Ambivalent”) represent specific response levels differing from the reference group.

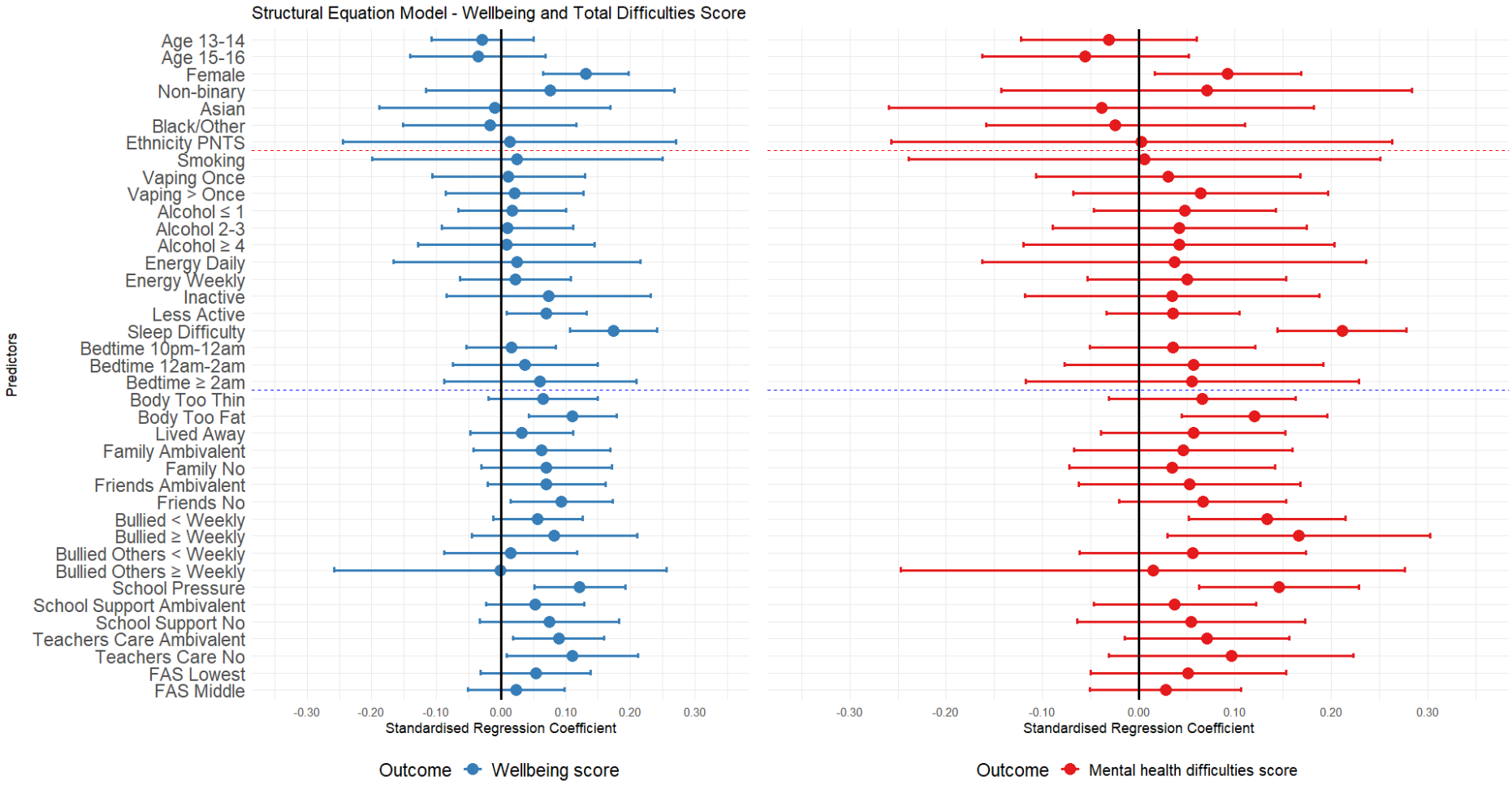

Figure S3. Estimated standardised regression coefficients and their 95% confidence intervals from a SEM examining the associations between explanatory variables across the two outcomes for the 2021 survey (N=89,339): WB (measured by the SWEMWBS scale, shown in blue) and MH (measured by SDQ Total Difficulties score, shown in red. Note: "Teachers care" and "Friends support" denote perceived teacher care and perceived friend support scales. Sub-categories (e.g., "Yes", "Ambivalent") represent specific response levels differing from the reference group. Dotted horizontal lines indicate the boundaries between the three predictor domains: Demographic, Behavioural, and Social factors.

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