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Validating a positive mental health measure with Portuguese adolescents and exploring associations with mental health perceived competencies

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Abstract

Background Positive mental health involves hedonic well-being (pleasure) and eudaimonic well-being (positive functioning). This construct can be assessed using the Positive Mental Health Questionnaire.

Aims This study sought to validate the short version of the Positive Mental Health Questionnaire for Portuguese adolescents, to assess positive mental health, perceived mental health competencies and sociodemographic factors, and to examine the correlations among these variables.

Methods An online survey with 514 secondary school students included sociodemographic questions, the Positive Mental Health Questionnaire and the Self-Assessment Scale of Basic Mental Health Action Competencies. Psychometric evaluations, descriptive analyses and linear regressions were conducted.

Results The Positive Mental Health Questionnaire demonstrated good item sensitivity, robust fit indices of the data collected concerning the previously recognised factorial structure, good internal consistency in factors, appropriate indicators of divergent and convergent validity, and test-retest reliability. Intermediate levels of positive mental health and good levels of perceived competence in mental health were found in adolescents. Older age and greater perceived knowledge about mental health, combined with less prior training in the area, contributed to higher eudaimonic well-being. Hedonic well-being was higher among those with a greater perception of self-care in mental health and less prior experience with mental health problems. Positive mental health was not significantly influenced by previous contact with individuals experiencing mental health problems or by the perception of mental health first aid.

Conclusions The Positive Mental Health Questionnaire proved to be a tool with good psychometric properties, adequately assessing adolescents' needs and the outcomes of mental health promotion initiatives. This work has also highlighted an opportunity to optimise adolescents' positive mental health, specifically in self-control, autonomy, and interpersonal relationship skills. Adolescents should be encouraged to care for their mental health and be informed

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that interacting with people with mental health problems does not present a significant risk to them. Through mental health training, adolescents' functioning can be enhanced over time, relying on the recognition of acquired skills. Findings can inform school-based and community strategies to promote adolescent mental health.

Keywords Adolescent, Competence, Health promotion, Mental health, Psychometrics, Correlation of data, Cross-sectional analysis

Background

Over the years, the concept of mental health has emerged as a complex continuum, differentiating itself from the traditional psychiatric and dichotomous view of “having a mental disorder or having mental health” [1, 2]. The World Health Organization defines mental health as “a state of mental well-being that enables people to cope with the stresses of life, realise their abilities, learn well and work well, and contribute to their community” [2]. Mental health can be understood along two axes: subjective well-being and symptoms of mental disorder. In turn, the subjective mental well-being (positive mental health) of individuals has been considered from a hedonic perspective (pleasure/positive feelings) and a eudaimonic perspective (positive functioning) [3]. Assessments and interventions by healthcare professionals must take into account the positive mental health of patients, as well as their symptoms of mental disorders [4].

Jahoda introduced the concept of positive mental health as a holistic and dynamic state, characterised by the ability to maintain a positive self-attitude, pursue personal growth, harmoniously integrate various aspects of the self, exercise autonomy, accurately perceive reality, and effectively manage one's environment [5]. While her framework remains influential, it was conceptual in nature and not intended for empirical measurement. Building on Jahoda's theoretical foundations, several approaches sought to conceptualise and measure positive mental health, including Ryff's Psychological Well-Being [6] and Lluich's pragmatic six-factor model [7]. Lluich proposed a structure organised into six factors: Personal Satisfaction – relating to self-esteem, life satisfaction, and optimism; Prosocial Attitude – involving altruism, helping others, and acceptance of differences; Self-control – entailing coping with stress and managing emotions; Autonomy – referring to independence, self-regulation, and personal confidence; Problem-solving and Self-actualisation – encompassing decision-making, adaptability, and continuous growth; and Interpersonal Relationship Skills – including forming relationships, empathy, and providing emotional support [7]. This approach was developed to support psychometric assessment and practical application, particularly in healthcare and educational settings. The Positive Mental Health Questionnaire (PMHQ) with 39 items was based on this multifactorial model [7]. The PMHQ was validated for the Portuguese adult population, namely for higher

education students [8]. Subsequently, a short version of the questionnaire was created for young adults (Positive Mental Health Questionnaire – Short Form of 18 items [PMHQ-SF18]) [9].

The different factors of positive mental health can show changes during adolescence. At this stage, individuals develop abstract and logical thinking, which enhances their capacity to reflect on themselves and others, anticipate consequences, and solve problems effectively [10]. These cognitive advancements support greater autonomy, emotional regulation and adaptive decision-making – core skills for coping with challenges and promoting mental well-being [11, 12]. Erikson described adolescence as a pivotal period of identity exploration, where individuals examine their uniqueness and social roles [13]. This process can lead to either identity consolidation or confusion, and plays a central role in developing a coherent self-concept [13]. A well-established identity provides adolescents with security and stability that support life satisfaction, psychosocial adjustment and well-being [14]. It is also associated with a stronger sense of purpose, greater self-efficacy and more positive interpersonal relationships [15–17]. Discrepancies between the “real self” and the “ideal self” may lead to self-criticism or feelings of inadequacy [18]. However, navigating these tensions can foster greater emotional awareness, self-compassion, resilience and growth-oriented coping strategies [19–21]. During adolescence, peer interactions become more frequent and influential than family relationships, fostering egalitarian and autonomy-supportive connections [22]. Moreover, adolescents are exposed to a variety of new social situations (e.g., more complex school environments, initial entry into the workforce) [23]. These dynamics play a crucial role in developing interpersonal skills that support personal growth, development, and adaptation [23]. Self-control also matures during this period, shaped by peer influences and social contexts; indeed, self-control and exposure to peer delinquency are reciprocally related [24]. This growing ability to manage thoughts, behaviours, and emotions is linked to experiencing less daily stress, reduced emotional reactivity and more effective coping strategies [25]. Significant social and emotional habits for mental well-being are established during adolescence (e.g., sleep, exercise, relationships and coping patterns) [26].

A high prevalence of common mental disorders among adolescents has been reported [27–29]. However, there

seem to be few studies assessing their levels of positive mental health. Despite the challenges experienced during adolescence, neither the long nor the short version of the PMHQ had been validated for the Portuguese adolescent population. Nevertheless, the instrument continued to be used with this group, even in the absence of psychometric evidence supporting its appropriateness [30]. Therefore, the validation of the psychometric instrument was considered pertinent, facilitating the representation of the phenomenon and its relationship with other constructs.

Although adolescence is typically defined as the period between 10 and 19 years of age [2], it is a heterogeneous phase marked by significant physical, psychological and social changes [31]. In Portugal, between the ages of 15 and 18, adolescents are expected to acquire competencies that enable them to perform tasks, solve problems, and take responsibility for their actions [32]. Prior to this stage, their cognitive and practical resources are more limited, making adult supervision necessary [32]. At 18 years old, individuals generally reach legal adulthood, becoming fully accountable for their decisions and behaviours [33]. Given these developmental and legal milestones, the period between ages 15 and 18 is particularly relevant. In this context, understanding adolescents' subjective well-being and perceived competence in mental health is essential to support their transition to adulthood.

Different social determinants of mental health have been described in the literature [34]. Campbell et al.'s study indicated that girls have poorer average mental health than boys (including measures of eudaimonia and hedonia) [35]. Similarly, Kieling et al. showed a higher prevalence of mental disorders in females during adolescence [27]. Thus, it is essential to monitor the relationship between positive mental health and the sex of adolescents. The scarcity of studies regarding the evolution of positive mental health over age makes the topic insufficiently understood and worthy of exploration. Positive mental health may decline throughout adolescence. According to data from 2019, 12.4% of adolescents aged 10 to 14 and 13.96% of those aged 15 to 19 experienced mental health disorders [27].

Individuals with a history of mental disorders are more likely to experience low levels of mental well-being [2, 36]. However, there do not seem to be studies associating adolescents' experiences of mental health problems (mental disorders and symptoms of a mental disorder that do not justify a diagnosis) with their positive mental health. Mental states have also been viewed as socially contagious. For instance, Chi et al.'s study reported parents transmitting subjective well-being and psychological distress to their adolescent children [37]. Laursen and Veenstra described that adolescents are very susceptible

to internalising the emotional states of their peers [38]. Therefore, it is crucial to investigate the relationship between previous contact with people with mental health problems and the positive mental health of adolescents.

Mental health training can also influence people's mental health. According to Bjørnsen et al., knowledge of how to obtain and maintain good mental health is positively associated with mental well-being [39]. Thus, interventions promoting mental health literacy are relevant. However, the effects of the presence (or absence) of mental health training on the well-being of trainees require exploration. For example, Mental Health First Aid Training Programmes, a widely studied and disseminated type of educational intervention, have shown inconclusive impacts on the well-being of their trainees [40].

Mental health competence has also been described as an important contributor to well-being in psychiatric and non-clinical samples [41]. Literature on adolescents' perceived competence to act in mental health appears limited. Therefore, it is important to quantify this construct and relate it to positive mental health. According to Costa et al., the perceived basic competence to act in mental health refers to the relevance given by laypeople to caring for their mental well-being and that of others, as well as their perception of ability in these activities [42]. Some studies related a similar construct, self-efficacy, to positive mental health. Self-efficacy (belief in one's ability to execute actions to achieve specific goals) was positively correlated with positive mental health [43]. These authors indicated that strong self-efficacy leads to high subjective well-being, optimism and life satisfaction.

Despite existing research, several gaps remain regarding positive mental health in Portuguese adolescents, namely in terms of psychometric validation of the PMHQ-SF18, analysis of construct levels, and understanding the influence of sociodemographic characteristics and perceived competence on individuals' well-being. Therefore, the present study sought to: (1) validate the PMHQ-SF18 for Portuguese adolescents; (2) assess Portuguese adolescents' levels of positive mental health and perceived competence to act on mental health; and (3) analyse how sociodemographic factors and perceived competence to act on mental health relate to adolescents' levels of positive mental health.

Methods

Participants

We recruited only adolescents aged 15 to 18 (i.e., secondary school students) living in Portugal. A non-probabilistic snowball sampling method was conducted. The researchers accessed the adolescents intentionally, promoting the study through youth groups (school, cultural, religious, and sports) and legal guardians. Subsequently, the researchers asked the adolescents to share the study

within their social networks. We sought responses from at least 180 adolescents to explore the psychometric properties of the PMHQ-SF18 (10 adolescents for each questionnaire item) [44].

Data collection

Data collection was carried out using an online form. The form included a sociodemographic assessment, the PMHQ-SF18 [9] (Additional file 1), and the Self-Assessment Scale of Basic Mental Health Action Competencies [Basic-MAC scale] [42]. The form was pre-tested with 20 adolescents to assess its comprehension, clarity and format. Participants were asked open-ended questions about these aspects. They confirmed that all items were understandable and did not suggest any changes to the PMHQ-SF18 or the rest of the form. The researchers provided the adolescents with a link or QR code to access the form.

Seven days after completing the form, participants were invited via e-mail/SMS to complete the PMHQ-SF18 online for a second time, with a one-week time-frame to do so.

Measures

The short version of the Positive Mental Health Questionnaire consists of 18 items (positively or negatively worded), distributed across six distinct factors [9], as presented in Table 1.

Responses are recorded on a 4-point Likert-type scale: 1 – Always or almost always, 2 – Quite often, 3

– Sometimes, and 4 – Rarely or never [9]. When analysing responses to the instrument, scores for positive items should be reversed [9]. Therefore, higher scores on the questionnaire represent higher levels of positive mental health [9]. The PMHQ-SF18 showed satisfactory internal consistency (factors with Cronbach’s alpha between 0.60 and 0.82 and MacDonald’s Omega between 0.62 and 0.83) [9].

The Basic-MAC scale is an instrument that measures perceived competence to act on mental health issues. It is a 5-point Likert-type scale of agreement, ranging from Strongly Disagree (1) to Strongly Agree (5) [42]. It has a structure with four factors: perception of knowledge about mental health (items 1–5), perception of mental health self-care (items 6–10), perception of interpersonal relationships (items 11–13), and perception of mental health first aid (items 14–20) [42]. The scale has been validated for Portuguese upper secondary school adolescents, showing good internal consistency (factors with Cronbach’s alpha and McDonald’s omega between 0.79 and 0.92, and composite reliability between 0.70 and 0.89) and good temporal stability (intraclass correlation coefficient between 0.77 and 0.80) [42]. The Basic-MAC scale evaluates both visible dimensions of mental health competence, such as knowledge, skills, and behaviours, as well as hidden aspects, including attitudes and motivation [42]. This dual focus aligns with the developmental changes typical of adolescence, a period in which both aptitudes and dispositions are rapidly and markedly evolving. Therefore, the scale is particularly suitable for this age group [42].

Statistical processing

The scores for the positive items on the PMHQ-SF18 were reversed. Data were analysed using IBM SPSS Statistics (version 27) and JASP (version 0.18.0) software.

Validation of the PMHQ-SF18

Means, standard deviations, medians, minimums, maximums, skewness, and kurtosis were estimated from adolescents’ responses to the PMHQ-SF18. Item sensitivity was examined. Absolute skewness values greater than three and kurtosis greater than ten would reveal significant discrepancies concerning the normal distribution of items [45].

A confirmatory factor analysis (CFA) was conducted to verify the fit of the pre-existing factorial structure to the observed data [46]. The maximum likelihood estimator was used in the CFA. The quality of the factorial fit was assessed based on the following indices: Chi-square (χ^2), Goodness-of-Fit Index (GFI), Root Mean Square Error of Approximation (RMSEA), Standardised Root Mean Square Residual (SRMR), Comparative Fit Index (CFI), Bentler-Bonett Normed Fit Index (BBNFI), and

Table 1 Short-form PMHQ items by factor, wording, and original correspondence [9]

PMHQ factors	Items of the short-form PMHQ (18 items)	Item Type: Positive (+)/ Negative (-)	Correspondence with the original version of 39 items
Factor 1: Personal Satisfaction	Item 1	-	Item 14
	Item 7	-	Item 31
	Item 13	-	Item 38
Factor 2: Prosocial Attitude	Item 2	+	Item 23
	Item 8	+	Item 25
	Item 14	+	Item 37
Factor 3: Self-Control	Item 3	+	Item 5
	Item 9	+	Item 21
	Item 15	+	Item 22
Factor 4: Autonomy	Item 4	-	Item 10
	Item 10	-	Item 13
	Item 16	-	Item 19
Factor 5: Problem-Solving and Self-Realisation	Item 5	+	Item 17
	Item 11	+	Item 32
	Item 17	+	Item 36
Factor 6: Interpersonal Relationship Skills	Item 6	-	Item 9
	Item 12	+	Item 20
	Item 18	-	Item 30

Bentler-Bonett Nonnormed Fit Index (BBNNFI). The following fit index values were considered acceptable: $\chi^2 \leq 3df$ and $p\text{-value} \geq 0.01$; $GFI \geq 0.90$; $RMSEA \leq 0.10$; $SRMR \leq 0.10$; $CFI \geq 0.90$; $BBNFI > 0.90$; and $BBNNFI \geq 0.90$ [45–47]. Additionally, the existence of a second-order factorial model was investigated. It was hypothesised that all factors would converge into a single latent variable (positive mental health).

The convergent validity of the questionnaire was examined using the Average Variance Extracted (AVE). AVE values of 0.5 or higher indicated adequate convergent validity [48]. For AVE values below 0.5, the construct may still be acceptable if Composite Reliability (CR) values are above 0.6 [48]. Divergent validity was assessed by comparing the AVE for each factor with the squared Pearson correlation between factors. An AVE greater than the squared correlation between factors indicated appropriate divergent validity [48].

Internal consistency for each factor was evaluated using Cronbach's Alpha (α), McDonald's Omega (ω), and Composite Reliability (CR) coefficients [49]. Values above 0.70 were considered adequate [50]. The test-retest reliability of the questionnaire was also assessed. Intraclass Correlation Coefficients (ICC) were estimated using a two-way mixed-effects model with absolute agreement for multiple raters/measurements [51]. ICC values below 0.5 represented poor reliability, 0.5–0.75 moderate, 0.75–0.9 good, and above 0.90 excellent [51].

Levels of perceived mental health competence and positive mental health

Mean scores were calculated for each factor of the PMHQ-SF18 [9] and the Basic-MAC scale [42]. These mean scores per factor were subjected to descriptive statistics (means, standard deviations, medians, minimums, and maximums). In the absence of reported cut-off points for the PMHQ-SF18 and the Basic-MAC scale, the mean scores for each factor were interpreted according to Table 2.

The interpretation of mean scores on the PMHQ-SF18 followed the proportion used in the original version of the questionnaire [8, 9]. The assessment of results on the

Basic-MAC scale considered the 5-point rating used by the instrument and the competence grading system of Portuguese schools (Very Poor to Very Good) [42].

Relationship between sociodemographic factors, perceived competence and positive mental health

A multiple linear regression was conducted. A model was considered with several independent variables (sex, age, previous experience with mental health problems, prior contact with individuals with mental health problems, previous mental health training and each of the four factors of the Basic-MAC scale) and dependent variable(s) (second-order latent variable(s) of the PMHQ-SF18).

Linearity and homoscedasticity were checked using a scatterplot, with one axis representing the Regression Standardised Residual and the other representing the Regression Standardised Predicted Value. A random and uniform distribution of residuals around zero along the predicted values would indicate that the regression model was linear and that the variance of the residuals remained constant across predicted values [52]. The independence of errors was assessed with the Durbin-Watson test. Values close to 2 in the test indicate that the residuals are not correlated, while values < 1 or > 3 would be concerning [52]. The normality of errors was examined through a histogram. Collinearity Statistics were applied. A Tolerance > 0.1 and a Variance Inflation Factor (VIF) < 10 would ensure the absence of multicollinearity (the relationship between multiple independent variables) [52]. Outliers (discrepant values outside the range of -3 to $+3$ on standardised residuals) were also checked, and their removal was considered [52].

Results

Data was collected from 12 March to 05 September 2023. In total, 514 and 198 adolescents responded to the questionnaire at the first and second time points, respectively. The average interval between the test and retest was 9.35 days (standard deviation: 2.68). The sociodemographic characteristics of the participants are available in Additional file 2.

Validation of PMHQ-SF18

Descriptive data on the questionnaire responses can be found in the “Item Sensitivity” section of Additional file 3. Skewness values between -1.21 and -0.14 and kurtosis values between -1.15 and 0.16 indicated good item sensitivity for the questionnaire.

Fit indices are available in the “CFA” section of Additional file 3. Suitable values were obtained for GFI, RMSEA, SRMR, CFI, BBNFI and BBNNFI. However, the χ^2 value was not appropriate. The factor structure of the questionnaire is represented in the “First Order Factor Model” section of Additional file 3. When testing a model

Table 2 Interpretation of mean scores for the factors of the scales used

PMHQ-SF18		Basic-MAC scale	
Mean Score	Interpretation related to positive mental health	Mean Score	Interpretation related to perceived competence to act in mental health
1–2	Low Level or Languishing	≈ 1	Very Poor
		≈ 2	Insufficient
2–3	Intermediate Level	≈ 3	Sufficient
3–4	High Level or Flourishing	≈ 4	Good
		≈ 5	Very Good

with a single second-order factor, estimation problems were encountered, notably a lack of convergence due to a Heywood case involving factor 5. Specifically, the standardised loading of the second-order factor on factor 5 exceeded 1, resulting in a negative variance and indicating model misspecification. Consequently, we considered the possibility of a different factor structure and conducted an exploratory factor analysis using the computed means of the six first-order factors. An oblimin rotation revealed two second-order variables (see “Second Order Factor Model” section in Additional file 3). After discussion among the researchers, labels were assigned to these

variables. Figure 1 summarises the factor structure of PMHQ-SF18.

All factors had AVE values higher than the Pearson correlation square between factors, indicating good divergent validity for the questionnaire. However, the AVE for factors 1 to 5 ranged from 0.50 to 0.67, while for factor 6, it was only 0.31. Thus, the questionnaire’s convergent validity was limited. These data are detailed further in the “Convergent & Divergent Validity” section of Additional file 3.

Factors 1 to 5 showed good internal consistency (ω and α ranging from 0.75 to 0.84, CR from 0.75 to 0.86), while factor 6 had unsatisfactory values for α (0.51), ω and CR

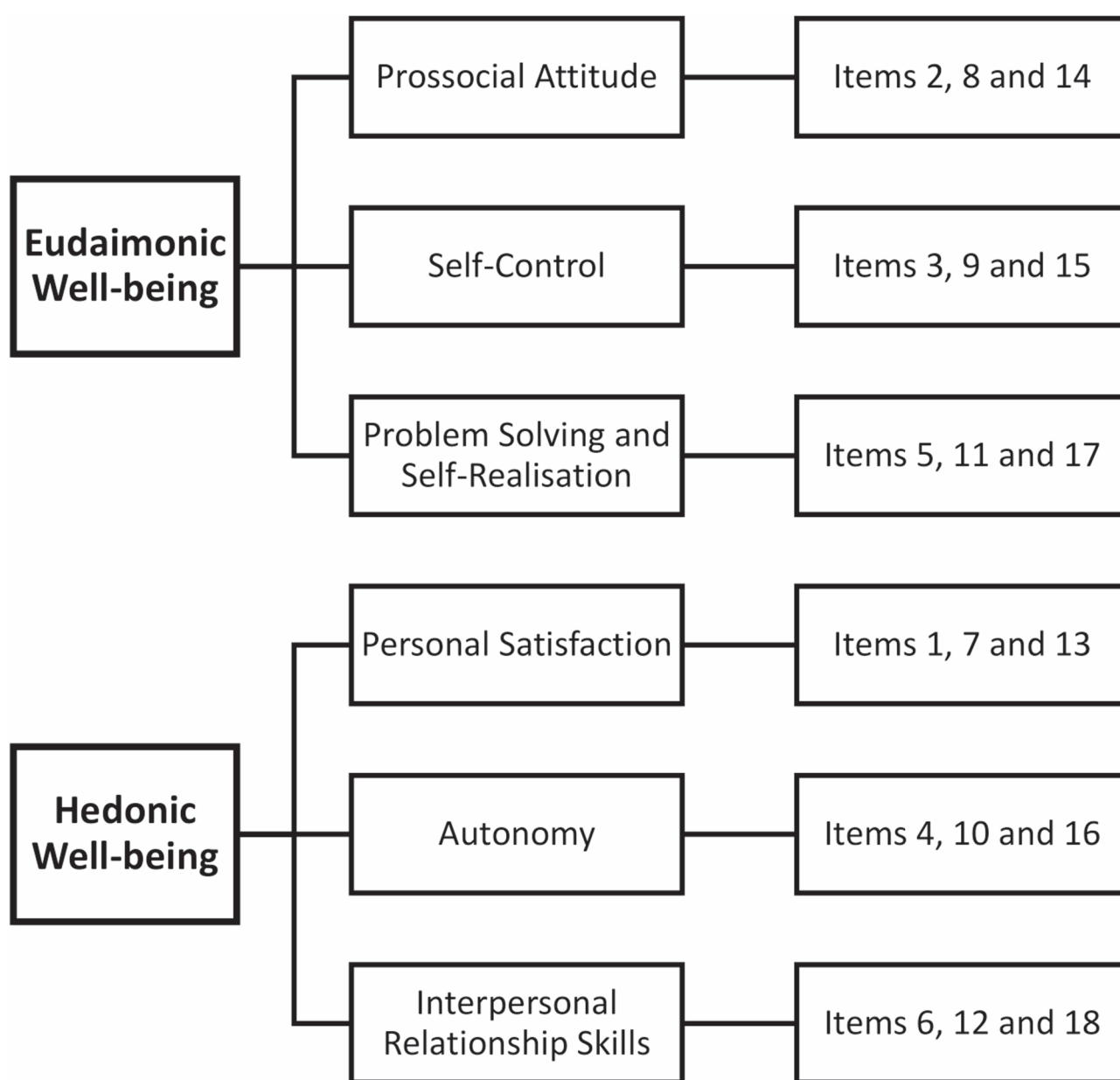


Fig. 1 Factor structure of PMHQ-SF18

(0.53) (see “Internal Consistency” section in Additional file 3). ICCs ranged from 0.609 to 0.775, reflecting good test-retest reliability in the different factors of the questionnaire (see “Temporal Stability” section in Additional file 3).

Levels of perceived mental health competence and positive mental health

Intermediate levels of positive mental health were found among the participants (mean score of 3.01 on Eudaimonic Well-being and 2.92 on Hedonic Well-being). They showed high levels of Personal Satisfaction, Prosocial Attitude, Problem Solving and Self-Realisation (mean scores of 3.10, 3.14, and 3.17, respectively) but intermediate levels of Self-Control, Autonomy, and Interpersonal Relationship Skills (mean scores of 2.73, 2.73, and 2.93, respectively). The mean scores for the factors of the Basic-MAC scale ranged from 4.02 to 4.18. In this way, a good level of competence to act in mental health was perceived by the participants. More detailed information can be found in Additional file 4.

Relationship between sociodemographic factors, perceived competence and positive mental health

Explaining Eudaimonic Well-being

A multiple linear regression model was created, with Eudaimonic Well-being as the dependent variable. It was significant ($F(9,504)=4.889$; $p<0.001$). The independent variables explained 8% of the variation in the dependent variable ($R^2=0.080$), with an adjusted R^2 of 0.064. Table 3 presents the relationships between the model's independent and dependent variables. Age and Perception of Knowledge about Mental Health positively and significantly correlated with Eudaimonic Well-being. In contrast, Previous Mental Health Training had a negative and significant correlation with Eudaimonic Well-being. No other variable showed a significant relationship.

The residuals were randomly distributed around zero, indicating linearity (Fig. 2). There appeared to be heteroscedasticity, as there was a higher concentration of points near the centre and a wider dispersion at the extremes (Fig. 2).

Tests were conducted that revealed significant heteroscedasticity (t-test: $F(9,504)=3.863$; $p<0.001$); White test: $\chi^2(50)=77.728$; $p=0.007$; Breusch-Pagan test: $\chi^2(1)=6.170$; $p=0.013$; and Modified Breusch-Pagan test: $\chi^2(1)=4.685$; $p=0.030$). Therefore, parameter estimates were made with Robust Standard Errors using the HC3 method [53]. The results were similar with and without correction for heteroscedasticity (Table 3).

The Durbin-Watson test value was 1.881, reflecting nearly independent residuals. The errors showed a slight negative skewness (Fig. 3).

A tolerance between 0.477 and 0.962 and a VIF between 1.040 and 2.098 confirmed the non-existence of multicollinearity. Standardised residuals ranged from $-2,950$ to $1,811$, supporting the absence of outliers.

Explaining hedonic well-being

A first multiple linear regression model was developed to explain Hedonic Well-being. The independent variables accounted for 9.3% of the variation in Hedonic Well-being ($R^2=0.093$). However, the standardised residuals ranged from -3.544 to 2.278 . In this regard, one outlier was identified and eliminated.

A final model was obtained. The independent variables accounted for 9.9% of the variation in Hedonic Well-being ($F(9,503)=6.120$; $p<0.001$; $R^2=0.099$; adjusted $R^2=0.083$). The relationships between the independent and dependent variables of the model are presented in Table 4. Perception of Mental Health Self-care positively correlated with Hedonic Well-being. In contrast, Previous Experience of Mental Health Problems had a negative correlation with Hedonic Well-being.

Table 3 Linear regression model considering the dependent variable “Eudaimonic well-being”

Parameters	Coefficients		Without correction for heteroscedasticity			With heteroscedasticity correction		
	B	β	SE	t	p	RSE	t	p
Intercept	7.806		5.231	1.492	0.136	5.114	1.526	0.128
Sex	-1.280	-0.091	0.662	-1.935	0.054	0.663	-1.932	0.054
Age	0.615	0.093	0.289	2.130	0.034*	0.285	2.159	0.031*
Previous Experience of Mental Health Problems	-1.031	-0.067	0.740	-1.394	0.164	0.730	-1.413	0.158
Previous Contact with People Experiencing Mental Health Problems	-0.015	-0.001	0.690	-0.021	0.983	0.728	-0.020	0.984
Previous Mental Health Training	-1.471	-0.107	0.604	-2.435	0.015*	0.625	-2.354	0.019*
Perception of Mental Health First Aid	-0.018	-0.013	0.086	-0.204	0.839	0.086	-0.205	0.838
Perception of Knowledge about Mental Health	0.218	0.112	0.099	2.190	0.029*	0.105	2.066	0.039*
Perception of Mental Health Self-care	0.173	0.095	0.101	1.715	0.087	0.088	1.959	0.051
Perception of Interpersonal Relationships	0.286	0.093	0.163	1.761	0.079	0.159	1.799	0.073

Legend: B Unstandardised Beta Coefficient, β Standardised Beta Coefficient, SE Standard Error, RSE Robust Standard Error

* - Statistically Significant (<0.05)

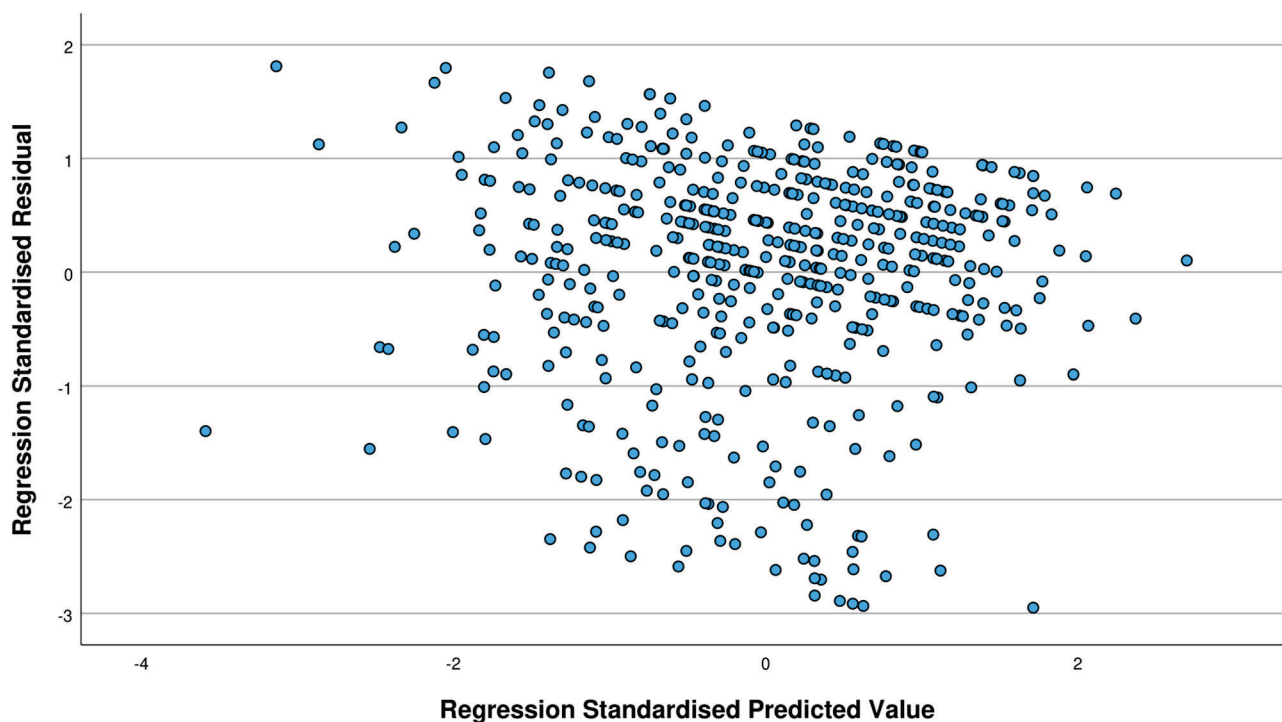


Fig. 2 Residual scatterplot of the explanatory model for “Eudaimonic Well-being”

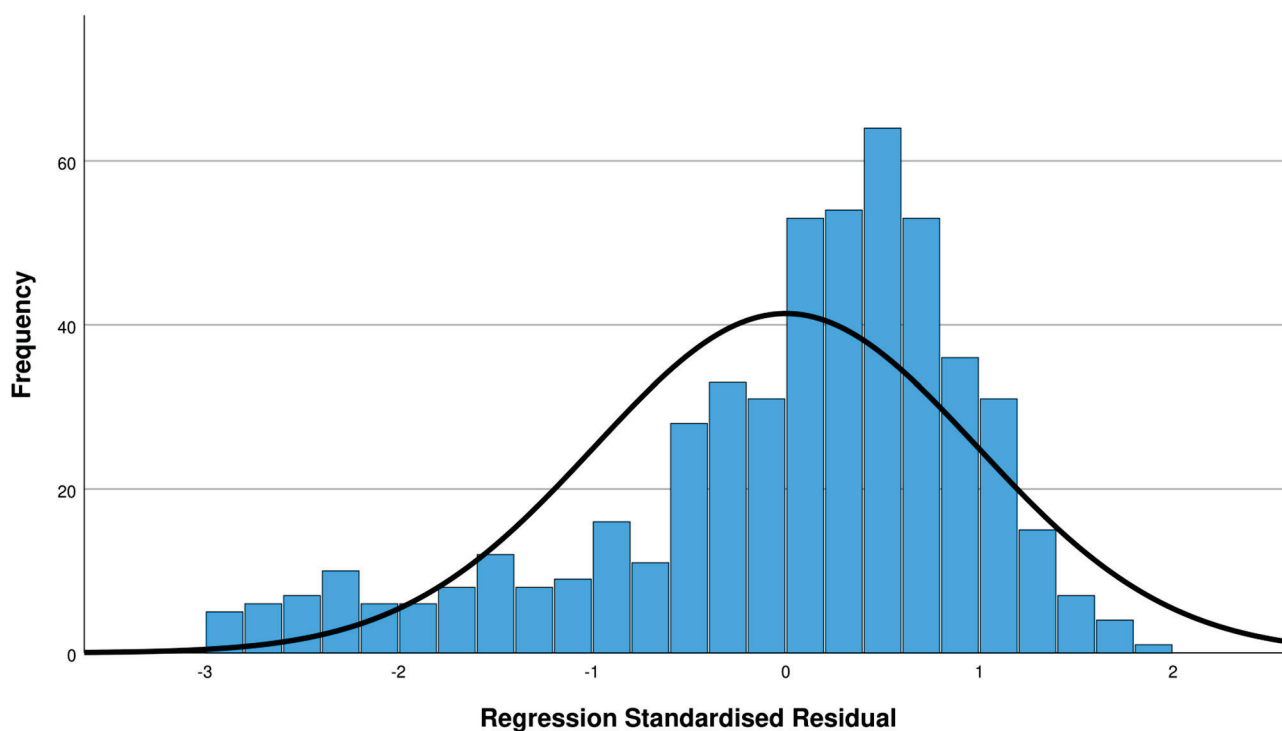


Fig. 3 Histogram of standardised residuals of regression for the explanatory model of “Eudaimonic Well-being”

The residuals were also randomly distributed around zero, indicating linearity (Fig. 4). However, there appeared to be slight heteroscedasticity, as the points were more concentrated in the centre and more dispersed

at the extremes (particularly in the negative predicted values) (Fig. 4).

Tests showed that heteroscedasticity was not significant (t-test: $F(9,503) = 0.798$; $p = 0.618$); White

Table 4 Linear regression model considering the dependent variable “Hedonic well-being”

Parameters	B	t	p
Intercept		3.963	0.000
Sex	0.039	0.846	0.398
Age	0.040	0.922	0.357
Previous Experience of Mental Health Problems	−0.174	−3.667	0.000*
Previous Contact with People Experiencing Mental Health Problems	0.040	0.868	0.386
Previous Mental Health Training	−0.017	−0.395	0.693
Perception of Mental Health First Aid	−0.071	−1.156	0.248
Perception of Knowledge about Mental Health	0.006	0.113	0.910
Perception of Mental Health Self-care	0.251	4.569	0.000*
Perception of Interpersonal Relationships	0.037	0.705	0.481

Legend: B Unstandardised Beta Coefficient

* - Statistically Significant (< 0.05)

test: $\chi^2(50) = 53.674$; $p = 0.335$; Breusch-Pagan test: $\chi^2(1) = 0.264$; $p = 0.607$; and Modified Breusch-Pagan test: $\chi^2(1) = 0.315$; $p = 0.575$). The residuals were independent, as the Durbin-Watson test value was 2.022. The errors exhibited a slight negative skewness (Fig. 5).

The independent variables were not highly correlated, as tolerance values ranged from 0.478 to 0.962, and VIF values ranged from 1.040 to 2.093. The final model no longer showed outliers, as the standardised residuals ranged from −2.849 to 2.306.

Discussion

This study validated the PMHQ-SF18 for adolescents. Likewise, we examined and related sociodemographic variables, levels of positive mental health, and perceived competence to act in mental health.

Validation of the PMHQ-SF18

The PMHQ-SF18 demonstrated good sensitivity, identifying specific variations in positive mental health [44].

Fit indices confirmed that the data adequately fit the factor structure previously recognised in other validations of the instrument. Although the chi-square test indicated significant misfit, this is likely due to the test’s sensitivity to large sample sizes [54]. Considering the overall pattern of results, the model fit can be regarded as acceptable.

This research was the first exploration of the existence of second-order variables in the PMHQ [7, 9]. Contrary to the hypothesis of a single second-order factor, exploratory analyses suggested the existence of two second-order factors, which seem to correspond to eudaimonic and hedonic well-being. This pattern may strengthen conceptual distinctions within the construct of positive mental health. On the one hand, the prosocial attitude was viewed as part of eudaimonic well-being, as altruism, empathy, and helping behaviour align with pursuing a meaningful and purposeful life [55]. Moreover, the ability to regulate emotions, thoughts, and behaviours enables the achievement of long-term goals [56]. Thus,

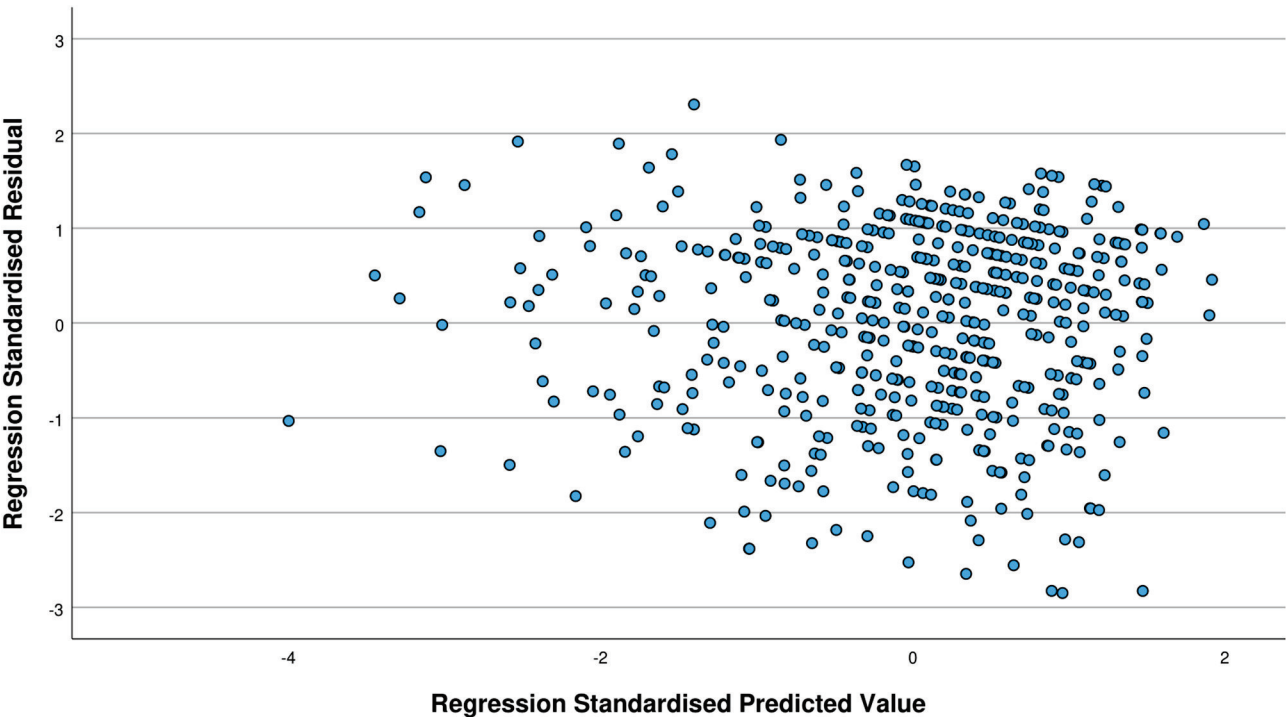


Fig. 4 Residual scatterplot of the explanatory model for “Hedonic Well-being”

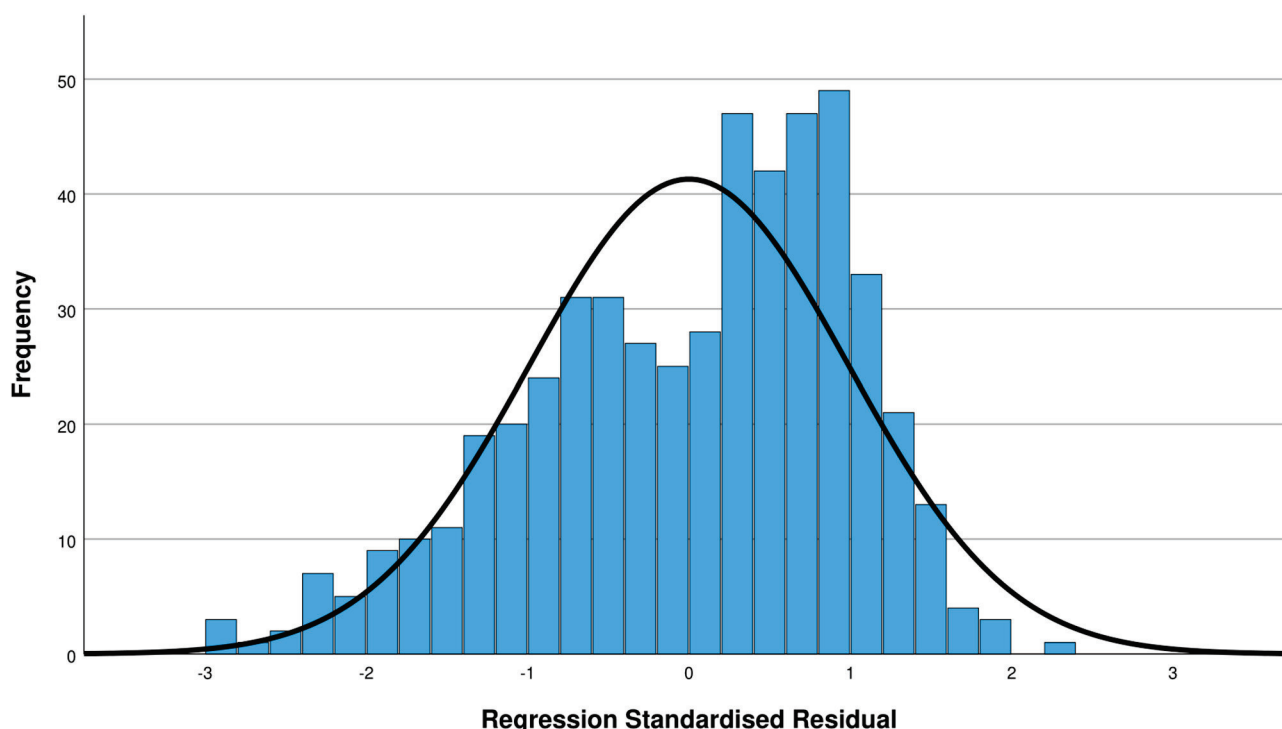


Fig. 5 Histogram of standardised residuals of regression for the explanatory model of “Hedonic Well-being”

self-control was considered a crucial element for realising human potential. The ability to face and overcome challenges (problem-solving) and continuous personal growth (self-actualisation) also reflects good individual functioning [57]. On the other hand, personal satisfaction was seen as part of hedonic well-being, as it involves a positive evaluation of one’s life and the experience of positive emotions [58]. We considered autonomy and interpersonal relationship skills part of hedonia despite the literature commonly viewing them as components of eudaimonia [57]. The questionnaire items related to autonomy specifically address concerns and the influence of others’ opinions on one’s actions (Additional file 1). The freedom to choose and act according to one’s desires can be a pleasurable experience [59]. Furthermore, (social) acceptance is a pleasant emotion [60]. The items related to interpersonal relationship skills reflect the individual’s feelings of comfort/security when interacting with others (Additional file 1). Positive social interactions motivate contentment [61].

The questionnaire demonstrated evidence of good internal consistency, except for factor 6. Overall, the instrument’s items correlate with each other and reliably measure the same construct [49]. Sequeira et al. also reported slightly lower reliability indicators for factor 6 compared to reference values. Thus, future studies should explore the limitations of this dimension [9].

The items appeared to converge on their intended construct and diverge from others, as adequate indicators

of divergent and convergent validity were obtained [48]. Inappropriate convergent validity values were only found in factor 6. Sequeira et al. found that factor 6 also showed suboptimal convergent validity, further underscoring the need for additional research into this dimension [9].

The questionnaire proved capable of assessing real and stable variations in the construct, as good test-retest reliability was observed [62]. The sample size enabled the detection of ICCs ≥ 0.60 between the two observations, with a 95% confidence level and 90% assurance in a bilateral comparison [62].

The PMHQ-SF18 is the first instrument validated to measure positive mental health (as a general construct) in Portuguese adolescents aged 15 to 18 [63]. It demonstrated good psychometric properties, making it an appropriate tool for assessing and providing evidence on the positive mental health of Portuguese adolescents. Data derived from the instrument can provide healthcare professionals and researchers with valuable insights into the challenges faced by individuals within this age group. The PMHQ-SF18 can support the development, implementation, and evaluation of the effectiveness of a wide range of real-world actions aimed at improving adolescent well-being. For example, psychotherapeutic interventions can be more precisely tailored based on identified strengths and vulnerabilities. Furthermore, educators can use this information to refine their teaching practices by integrating mental health promotion strategies into classrooms to foster a supportive learning

environment. Youth programmes and community initiatives can also leverage data from the PMHQ-SF18 to create or adapt environments that promote resilience, social connectedness, and emotional regulation, ultimately contributing to healthier developmental trajectories. Moreover, it can guide policymakers in decisions that influence the subjective well-being of their citizens. The adaptation/validation of the instrument for other contexts is a research avenue that could facilitate a broader understanding of the state of populations.

Levels of perceived mental health competence and positive mental health

Favourable results were found in positive mental health and perceived mental health competence among adolescents. However, a potential for improvement was identified in both constructs, which could be addressed through the implementation of psychoeducational interventions, specifically those aimed at promoting positive mental health literacy [64]. Formations such as those reported by Schiavon et al. [65] and Costa et al. [66] do not prepare individuals to manage psychiatric disorders, but rather equip them to promote pleasure and/or optimise functionality.

The intermediate levels of Self-Control, Autonomy, and Interpersonal Relationship Skills warrant reflection. Adolescents struggle to manage the tension between motivational and control processes in emotional contexts due to the less mature development of the prefrontal control regions [67]. Although biological factors are related to this capacity in adolescents, experience plays a key role in the development of self-control [67]. Therefore, they should be exposed to a wide range of everyday situations (and not overprotected) to improve their self-control [68]. Similarly, the desire for autonomy increases throughout adolescence. Satisfying this basic psychological need requires that contexts allow for curious exploration of the environment, as well as choice and accountability for behaviours [68]. Additionally, interpersonal relationships have presented new challenges. Young people are the most prominent social media consumers [69]. Thus, it is crucial to support the balanced development of adolescents' skills for both virtual and in-person interactions [69]. These findings underscore critical dimensions for development. They should be systematically addressed through evidence-based activities integrated into schools and other adolescent settings [65].

Relationship between sociodemographic factors, perceived competence and positive mental health

The requirements for conducting the linear regression were generally met. Although the distribution of errors showed a slight negative skew, the large sample size ensures the validity and precision of the confidence

intervals and significance tests, according to the Central Limit Theorem [70]. Furthermore, heteroscedasticity was corrected [53].

The R^2 values, representing the proportion of variance explained by the models (8.0% for Eudaimonic and 9.9% for Hedonic Well-being), indicate medium effect sizes, according to Cohen's guidelines [71]. This reflects a meaningful but not large contribution of the predictors, which is expected given the complex and multifactorial nature of well-being [2].

The linear regression provided valuable insights into the positive mental health of adolescents. Sex did not appear to explain eudaimonic or hedonic well-being significantly. However, given the higher prevalence of mental health problems among females, particularly between the ages of 15 and 19 [72], sex remains an important variable to consider in relation to mental health.

Despite the narrow age range in the sample, older age seems to be associated with higher levels of eudaimonic well-being. Gentzler et al. also showed increased eudaimonic motivation throughout adolescence [73]. The increase in purpose identification with age has also been reported [74], which makes sense considering the development of identity at this stage [13] and the maturation of cognitive abilities that allow reflection on existential matters [10]. Life experiences can promote personal development, optimising individuals' functioning [75]. Age did not significantly explain variations in hedonia, as also found in the study by Gentzler et al. [73].

Previous Experience of Mental Health Problems reflected in lower hedonic well-being. Mental health problems include emotional dysregulation, which can lead to the emergence of negative emotions [76]. The reported hedonia may be inhibited by the continuation of mental health problems up to the time of completing the questionnaire or by the recollection of previous problems, which may lead to a "presentification" of the negative experience. In youth settings (e.g., schools), particular attention should be given to adolescents with a history of mental health problems. Psychosocial support can be provided to help reduce negative emotions and foster positive experiences [77]. Previous Experience of Mental Health Problems was not significantly related to eudaimonic well-being. Although such problems can affect functioning [76], this impact may have been buffered by resilience [78].

Previous contact with people experiencing mental health problems and perception of mental health first aid did not explain variations in hedonia or eudaimonia, suggesting a limited influence of such interactions on an individual's mental health. Other aspects of contact, such as its nature and context, could be important to explore in future research to better understand mixed findings in the literature. Based on the current results, interactions

with people experiencing mental health problems should be encouraged. Adolescents could be empowered to help others, as mental health first aid seems to be harmless for adolescent aiders and potentially beneficial for those being helped [40].

Previous mental health training was associated with lower eudaimonic well-being, while a greater perception of knowledge about mental health was linked to increased eudaimonia. These findings warrant further investigation. One possible explanation is that mental health training may expose adolescents to difficult realities (such as the high prevalence of mental disorders among adolescents and their potential role as helpers). This exposure might lead them to question or reevaluate their previous sense of purpose and achievement, possibly causing a “deconstruction” of their earlier beliefs about themselves and their role in the world [79]. In contrast, perceiving oneself as knowledgeable about mental health may enhance confidence in facing these challenges. According to the Kruger and Dunning effect, individuals at the beginning of learning a topic often overestimate their competence, but as they become more aware of the complexities involved, their confidence may temporarily decrease [80]. However, once they gain genuine knowledge and skills, their confidence increases realistically, helping them feel more capable and effective in their efforts [80]. Thus, while formal mental health training might initially unsettle adolescents’ sense of purpose, a strong perception of knowledge can support greater eudaimonic well-being by fostering a sense of competence.

In this context, we recommend that mental health training be delivered in a structured and continuous manner to promote solid competency development. However, we believe it should go beyond simply offering learning opportunities. We suggest that it encourages them to recognise the knowledge they have acquired. For example, “Empower4MentalHelp”, a new mental health first aid training programme, includes activities designed for this purpose [66]. These encourage participants to apply theoretical knowledge in practice (e.g., through role-playing), review what they have learnt and recognise their daily role as mental health first aiders (e.g., through questions and discussions) [66].

Previous mental health training and perception of knowledge about mental health did not impact hedonic well-being. It is crucial to investigate existing educational interventions and whether they empower adolescents with ways to increase their positive emotions and satisfaction with life.

A greater perception of mental health self-care led to higher hedonic well-being, though it did not significantly affect eudaimonia. Intentional self-care practices help individuals cope with negative emotions and promote positive emotional experiences [81]. Therefore, these

practices should be taught and encouraged. However, actions that reflect purpose, promote personal growth and strengthen the connection to social values are essential for experiencing a more profound sense of well-being associated with a fulfilling and meaningful life [82].

In the future, other independent variables could be considered. For example, personal identity (e.g., gender, sexual orientation), personal history of physical health problems, family history of mental health, lifestyle (e.g., practices such as physical exercise, diet, coping strategies used, use of mental health services), living conditions (e.g., education and work conditions), family and social support (e.g., quantity and quality of relationships), socioeconomic level (family income, parents’ education level, parents’ occupation, housing conditions, access to resources), cultural factors (e.g., religion, ethnicity), and environmental factors (e.g., migration, climate, pollution) have been reported as influencers of mental health [83, 84].

Limitations

This study has limitations. Firstly, the non-probability snowball sampling limits the generalisation of the data. Adolescents were initially recruited through youth groups and then asked to disseminate the study via their personal social networks. This recruitment process may have introduced self-selection bias, as participation depended on individual motivation and interest, potentially excluding less engaged profiles. The possibility of completing the form online and remotely hindered control over the environment in which the adolescents responded, and the number of questions in the form may have been considered excessive by the respondents. Although commonly used in the literature, the time interval between the test and the retest could have been longer, ensuring that the reliability levels were not due to any recall of previously answered questions in the retest. Finally, the questionnaire was validated for a narrow age range (15 to 18 years), which limits the applicability of the findings to younger or older adolescents. Developmental differences across adolescence may affect how participants understand and respond to mental health measures. Therefore, caution is warranted when attempting to generalise these results to broader adolescent populations or different cultural contexts.

Conclusions

This study successfully validated the PMHQ-SF18 for Portuguese adolescents. The questionnaire demonstrated good psychometric properties, adequately measuring this population’s positive mental health. Intermediate levels of positive mental health and good levels of perceived mental health competence were determined, recognising the importance of planning, implementing, and

evaluating interventions to promote literacy on positive mental health. Positive mental health was represented in the PMHQ-SF18 by eudaimonic and hedonic well-being. Recognising these two dimensions in Portuguese adolescents offers a novel contribution to the understanding of the construct and its underlying influences. Eudaimonia was partially explained by age, perception of knowledge about mental health and previous mental health training. Previous experience of mental health problems and perception of mental health self-care impacted hedonia. The influence of other variables on positive mental health should be considered in future research. In sum, the PMHQ-SF18 is a practical tool that can effectively support efforts to promote positive mental health among Portuguese adolescents.

Abbreviations

α	Cronbach's alpha coefficient
χ^2	Chi-square
ω	McDonald's omega coefficient
AVE	Average Variance Extracted
Basic-MAC scale	Self-assessment Scale of Basic Mental Health Action Competencies
BBNFI	Bentler-Bonett Normed Fit Index
BBNNFI	Bentler-Bonett Nonnormed Fit Index
CFA	Confirmatory factor analysis
CFI	Comparative Fit Index
CR	Composite Reliability
ICC	Intraclass Correlation Coefficients
GFI	Goodness-of-Fit Index
PMHQ	Positive Mental Health Questionnaire
PMHQ-SF18	Positive Mental Health Questionnaire – Short Form of 18 items
RMSEA	Root Mean Square Error of Approximation
SRMR	Standardised Root Mean Square Residual
VIF	Variance Inflation Factor

Supplementary Information

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Supplementary Material 1.
Supplementary Material 2.
Supplementary Material 3.
Supplementary Material 4.

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Authors' contributions

All authors (TFOC, ARMP, PRSC, CACS, MTLC, FMCS) made substantial contributions to the conception and design of the study, and the first author (TFOC) performed the acquisition, analysis and interpretation of data. The first author (TFOC) wrote the manuscript, and all authors (TFOC, ARMP, PRSC, CACS, MTLC, FMCS) critically reviewed its content. All authors (TFOC, ARMP, PRSC, CACS, MTLC, FMCS) approved the final version of the manuscript and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Data availability

The datasets generated and/or analysed during the current study are not publicly available due to privacy or ethical restrictions but are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The ethical principles outlined in the Declaration of Helsinki and the Oviedo Convention were respected. The study was approved by the Bioethics Committee of the Universitat de Barcelona (Institutional Review Board: IRB00003099; date: 21 February 2021) and the Ethics Committee of the Portuguese Society of Mental Health Nursing (Institutional Review Board: CEASPESM_1/2023; date: 10 March 2023). Adolescents provided written informed consent, and legal guardians authorised minors' participation.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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