



The most salient global predictors of adolescents' subjective Well-Being: parental support, peer support, and anxiety

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Abstract

The present study examined the globally relevant predictors of adolescents' subjective well-being (SWB) using data from the Programme for International Student Assessment (PISA) 2015 Student Questionnaire. Guided by the social-cognitive-behavior model (Suldo et al., 2008) and self-determination theory (Ryan & Deci, 2000), nine variables were selected and subjected to a statistical procedure of decision tree modeling (DTM). Our results showed that parent and peer support were the most salient predictors of adolescents' SWB across all eight world regions under investigation, followed by anxiety and gender. However, we also noted some variations in the relative importance of parent and peer support and multiple pathways that lead to SWB. The study concludes with practical implications.

Keywords Subjective well-being · Parent support · Peer support · Anxiety · Decision tree

1 Introduction

Subjective well-being (SWB) may be the “*be-all and end-all*” for most people. SWB is defined as “a person’s cognitive and affective evaluation of his or her life” (Die-

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ner et al., 2002, p. 63) and is believed to be influenced by individuals' subjective judgments and feelings about themselves, environments, and their achievements. In recent years, international projects have been established to understand the globally relevant predictors of SWB. Such projects include the World Happiness Report (Helliwell et al., 2020) by the United Nations General Assembly in 2011, the Better Life Initiative of the Organisation for Economic Co-operation and Development (OECD, 2020) that was initiated in 2011, and the European Social Survey of the European Research Infrastructure Consortium (ERIC, 2021). Some of the major findings from these projects were that individuals from Nordic and Western Europe were happier than individuals in other parts of the world. The reasons for this result might be associated with national economic development and social welfare systems. System-level factors influence people's perceptions about personal experiences concerning housing, safety, work-life balance, and a sense of community (Helliwell et al., 2020). As such, large-scale international research has mainly focused on macro-level and policy-driven influences. However, little attention has been given to the global and developmentally relevant predictors of SWB in *adolescents*.

SWB is associated with a range of life outcomes, including educational attainment, mental health, and social relationships (van Ryzin et al., 2009; Walsh et al., 2010). Poor development of SWB during adolescence may have consequences for later development in those areas. It has been found that SWB tends to gradually decrease during secondary schooling (Casas & González-Carrasco, 2019; Eccles & Midgley, 1989); thus, it is important to understand the protective factors associated with SWB in young adolescents.

Based on the Programme for International Student Assessment (PISA) 2015 Student Questionnaire data, the present study aimed to examine the globally relevant predictors of SWB and the pathways that lead to SWB among adolescents living in different parts of the world. To understand the potential pathways associated with SWB, an advanced multivariate statistical analysis known as decision tree modeling (DTM) was adopted. The main advantage of DTM is that it can find an unlimited number of interactions among a set of predictors so that researchers and practitioners can understand the complex relationships between a set of predictors and the outcome variable, which in our case is well-being (see Method for a detailed description of DTM).

2 Literature Review

The present study's conceptual framework was guided by the social-cognitive-behavior model (SCB; Suldo et al., 2008) and self-determination theory (SDT; Ryan & Deci, 2000). The SCB model (Suldo et al., 2008) proposes that school climate (i.e., the disciplinary school climate, peer relationships, parental involvement, school resources, and school building quality), academic achievement, and in-school conduct (e.g., cheating on tests, fighting between students) are linked to adolescents' attachments to school and academic beliefs (i.e., academic self-perception, motivation, self-regulation, and goal valuation), which in turn contribute to their satisfaction toward school and life in general. Thus, the SCB model (Suldo et al., 2008)

suggests that academic correlates and school factors are important predictors of adolescents' SWB. These relevant factors range across social, cognitive, and behavioral dimensions. To reflect this tenet of the SCB model, we examined adolescents' social relationships with teachers, peers, and parents (social dimension), academic motivation and thoughts and feelings about schoolwork or tests (cognitive dimension), and achievement (behavioral dimension) in the current study.

Self-determination theory (SDT; Ryan & Deci, 2000) articulates how individuals' SWB may be influenced by their cognitive behaviors and social environments. Specifically, it posits that relatedness, autonomy, and competence are basic psychological needs that are the foundation of people's SWB. Relatedness within the SDT framework is highly relevant to our study on adolescents' SWB because a substantial amount of well-being research has supported the importance of social connections and social support to regulate emotion by developing coping strategies when experiencing stressful life events (Diener et al., 2006). SDT also posits that students engage in self-initiated and self-motivated tasks when they have an autonomous form of motivation. Thus, students are likely to experience better SWB in such situations. Highly motivated students tend to possess high levels of vitality, excitement, and self-esteem, and lower levels of negative psychological symptoms (Tuominen-Soini et al., 2008). The last component of SDT competence may also have a role in adolescents' SWB, as the theory suggests that when students experience a sense of fulfillment or feel competent in what they do, they are more likely to experience high levels of SWB (Ryan & Deci, 2000). Overall, SDT provides a theoretical argument for the importance of relatedness, autonomy, and competence in examining adolescents' SWB. In the present study, we included social support (relatedness), motivation (autonomy), and academic achievement (competence) as potential predictors of adolescents' SWB.

Reflecting on the main components of the SCB and SDT, there was an overlap in the emphasized constructs, which we employed and organized into three groups: (a) perceived social support from parents, teachers, and peers, which we refer to as *perceived social support in the school environment*; (b) school-related disposition and academic outcomes (i.e., academic motivation, anxiety, and academic achievement), which are labeled *secondary disposition and school-related outcomes*; and (c) students' demographic background variables, which are labeled *primary characteristics*. The following sections illustrate how the extant literature has demonstrated the link between our study variables and SWB.

2.1 Social Support and Subjective Well-being (SWB)

Both theoretical and empirical studies have consistently recognized the importance of social connections and social support for mental health and well-being (Baumeister & Leary, 1995; Cohen & Wills, 1985; Diener et al., 2002; Lansford, 2018). Perceived social support is associated with feelings of security, pride, and connection to a group, which enhance a sense of purpose in life and well-being. As mentioned above, SDT (Ryan & Deci, 2000) posits that individuals' psychological needs for relatedness, along with a sense of autonomy and competence, are crucial for positive

feelings about their well-being (Chu et al., 2010; Greenberg et al., 1983; Walsh et al., 2010; Young et al., 2005).

Primary sources of social relationships for most adolescents are derived from parents, peers, and teachers (Collie et al., 2016). The school environment provides an important context for students to initiate and build social relationships (van Ryzin et al., 2009; Virtanen et al., 2019; Wilkinson, 2010). During adolescence, students desire autonomy from their parents and invest more time and energy in social relationships with peers (Eccles & Midgley, 1989). Having a good-quality peer relationships is linked to various aspects of school life, including school engagement, emotional regulation, behavioral adjustments, and better SWB (van Ryzin et al., 2009; Virtanen et al., 2019; Wilkinson, 2010).

Although adolescents may perceive peers as the most important social group from which to create and enrich their social life, researchers have pointed out that parental support still plays a critical role in developing adolescents' SWB and mitigating negative developments in mental health. For instance, Lansford (2018) reported that the perception of family support as supportive, warm, and responsive was linked to the SWB of individuals across lifespan and different cultural groups. For students, teacher support also plays an important role. For example, Suldo et al. (2008) reported that adolescents with a higher level of teacher support were more likely to have positive interpersonal relations with others ($r=.60$) and better life satisfaction ($r=.33$). Suldo et al. (2009) also found that students' SWB and teacher support were moderately correlated ($r=.32$ to 0.38). Lawler et al. (2017) demonstrated the relative importance of family relationships ($\beta=0.31$), peer relationships ($\beta=0.17$), and parent involvement ($\beta=0.08$) in predicting life satisfaction in a sample of American adolescents. Additionally, the relative importance of family ($\beta=0.18$), peer ($\beta=0.18$), and parent involvement ($\beta=0.06$) was demonstrated in the combined international sample. While teacher support did not significantly predict life satisfaction in either sample in Lawler et al. (2017), Collie et al. (2016) reported that both teacher support and peer relationships were significantly related to adolescents' school enjoyment ($\beta=.41$; $\beta=.41$), yet parental support was not significantly related to school enjoyment. Thus far, the existing studies have pointed to the importance of perceived social support from parents, teachers, and peers for adolescents' SWB. However, there are mixed results on the relative importance and contribution to adolescents' SWB from each social source. Furthermore, the extant research tends to be limited to one or only a few cultural/national groups. Hence, it is largely unknown whether social-related predictors of SWB are globally relevant for adolescents worldwide. To our best knowledge, there has not been a systematic investigation to conclude whether and how these three sources of social support may play a role in adolescents' SWB across many different cultural groups. Our current study aims to provide evidence concerning these issues.

2.2 Secondary Disposition and Outcomes Relating to Schoolwork

Academic Achievement and Subjective Well-being (SWB). Adolescents who demonstrate better academic performance may feel good about themselves and have better SWB. However, meta-analysis studies have suggested only a weak relationship

between SWB and academic performance (Bücker et al., 2018; Huang, 2015). For instance, Bücker et al. (2018) synthesized 151 effect sizes from 47 studies across primary, secondary, and higher education settings in North America, Europe, Asia, and Oceania. They reported weak associations between SWB and academic achievement ($r=.16$), between academic satisfaction and academic achievement ($r=.18$), and between overall life satisfaction and academic achievement ($r=.17$). Another meta-analysis based on 43 longitudinal studies also showed a similar effect size ($r=-.15$) between prior academic achievement and subsequent depression (Huang, 2015).

Other researchers have explored the indirect effect on the relationship between academic achievement and SWB. For instance, Suldo et al.'s (2008) path model demonstrated that academic achievement has direct links to personal academic beliefs ($\beta=0.26$) and attachment to school ($\beta=0.24$), which in turn were directly linked to school satisfaction, which affects adolescents' global life satisfaction ($\beta=0.22$). Thus, prior studies have suggested that academic achievement may not be directly linked to SWB. However, academic achievement is still an integral part of adolescents' school life and associated feelings and beliefs from school experiences. SDT posits that students' feelings and beliefs about their own competence can contribute to their SWB. Thus, this study investigates both direct and indirect relationships between academic performance and SWB via DTM among adolescents from 47 countries.

Academic Motivation and Subjective Well-being (SWB). SDT (Ryan & Deci, 2000) posits that adolescents with autonomous academic motivation have better SWB because their internalized motivation helps them experience vitality, excitement, self-esteem, and a lower level of negative psychological symptoms (Tuominen-Soini et al., 2008). On the other hand, highly motivated students may tend to feel pressured to outperform other students, experience emotional vulnerability from a temporary setback, and seek external validation for their achievement (Kaplan & Maehr, 1999; Tuominen-Soini et al., 2008, 2012). Thus, academic motivation can indirectly affect SWB through a social comparison process (Marsh, 1987; Marsh & Hau, 2003). For example, students in a high-ability group may compare themselves to students who outperform them in school. Consequently, students in high-ability groups may have a low self-concept level and feel anxious about their schoolwork (Frenzel et al., 2007; Samela-Aro et al., 2008). In such cases, highly motivated students may be more emotionally vulnerable and have a lower level of self-esteem and a high level of negative emotions, all of which contribute to poor perception of SWB. Similar to the studies on the relationship between academic achievement and SWB, there is limited knowledge about how academic motivation may influence adolescents' SWB based on international data representing a range of different cultural/national groups.

School/Test Anxiety and Subjective Well-being (SWB). Adolescents with high anxiety may have difficulty feeling a great sense of SWB (Diener & Emmons, 1984; Stankov et al., 2014). Anxiety is driven by negative thoughts and self-doubt, which can drain mental energy to perform daily tasks (Cassady & Johnson, 2002; Spielberger & Vagg, 1995). Students' anxiety and self-doubt about learning may directly or indirectly influence SWB through school performance (Lee, 2009; Stankov, 2010; Stankov et al., 2014). However, empirical evidence often documented small or moderately weak effect sizes, ranging between $r=-.14$ and -0.23 , between life satisfaction and worry (Steinmayr et al., 2016). Furthermore, Suh et al. (1998) pointed out

that cultural characteristics inherently moderated the effect sizes of SWB predictors across countries. Specifically, they found that the effect size of emotion ($\beta=0.556$) in multiple regression was far greater than the effect size of the perception of social norms ($\beta=0.161$) in individualist countries. In contrast, the effect sizes for emotion ($\beta=0.342$) and norms ($\beta=0.345$) were similar in collectivist countries. This result was based on a large sample of college students from 40 countries ($N=6,700$). Our study extended the previous literature by examining the role of negative feelings and anxiety on *adolescents'* SWB across 47 countries.

2.3 Primary Characteristics

Gender and Subjective Well-being (SWB). A review by Lansford (2018) concluded that women were more likely to report both higher life satisfaction and negative emotion-based psychological symptoms, such as anxiety and depression, than men. On the other hand, the Better Life Initiative by the OECD (OECD, 2020) found no gender difference in adolescents' life satisfaction across 32 OECD countries, where the SWB rating of both groups was reported to be exactly 7.4 on a ten-point scale. Huebner (2004) also did not find gender differences in life satisfaction across the lifespan from childhood to adolescence. Suldo et al. (2009) also noted that gender differences in adolescents' life satisfaction were found only in the qualitative portion of their study, whereas there was no difference in their quantitative analysis. While the effect of gender on young adolescents' SWB is unclear, gender is often associated with differences in behaviors and emotions, including regulation of psychological and mental resources and attitudes (Hill & Lynch, 1983; Priess et al., 2009). Currently, empirical evidence on the relationship between gender and SWB in *adolescents* has not been examined using large-scale cross-national data.

Family Socioeconomic Status (SES) and Subjective Well-being (SWB). It is well established that family socioeconomic status (SES) is positively correlated with children's life experiences and outcomes (e.g., academic achievement; see Lee et al., 2019). However, whether and how much family SES contributes to school-aged adolescents' SWB has not been well established (Sweeting & Hunt, 2014). For example, Ma and Huebner (2008) found that family SES exhibited almost zero correlation with the life satisfaction of middle school students for both boys and girls (ages ranging from 10 to 16 years). In addition, a longitudinal study also demonstrated a weak association between family income at age 16 and general life happiness ($r=.12$) and social relationship satisfaction ($r=.09$) in later life during adulthood (Louis & Zhao, 2002). The empirical evidence suggests that the link between family SES and SWB may not be as strong as the association that is often reported for the SES-achievement association. Nevertheless, family SES may be a protective factor for adolescents' school experiences, emotional regulation, and learning outcomes (Lee et al., 2019; Somerville & Whitebread, 2019), which may influence how adolescents view their life and achievement and SWB.

Immigration and Subjective Well-being (SWB). Empirical findings of the impact of immigration on adolescents' SWB are ambivalent. For example, life satisfaction was lower among immigrant students than among their native peers in studies conducted in Finland (Liebkind & Jasinskaja-Lahti, 2000) and Portugal (Neto, 2001).

Conversely, no difference was reported in recent studies from Canada (Berry & Hou, 2017), Spain (Rodríguez et al., 2020), and Italy (Alivernini et al., 2020). National policies on immigration vary and are a highly contextual issue. Thus, a broad range of countries and world regions need to be systematically examined to better understand the impact of immigration on adolescents' SWB.

3 The Present Study

Although SWB is a heavily researched construct, the extant research has not been clear about its salient predictors among adolescents from different cultural/national groups. The present study aimed to: (a) identify the global predictors of adolescents' SWB, and (b) examine the pathways through which adolescents obtain a low and high levels of SWB across the eight world regions. Guided by SCB and SDT, we examined the relative importance of social support from parents, peers, and teachers, secondary disposition, and outcomes relating to schoolwork and school performance (i.e., academic achievement, academic motivation, and school-related anxiety), and demographic background variables (i.e., gender, family SES, and immigration status).

Based on the existing research on SWB, we had initial expectations about our study variables. First, a large volume of SWB research has emphasized the importance of social support on SWB; thus, we expected that social support would be the most salient predictor of SWB, possibly across different cultural/national groups. However, the relative salience of the three types of perceived social support from parents, peers, and teachers in relation to adolescents' SWB across cultures is largely unknown for us to form an informed assumption. Second, based on recent cross-sectional and longitudinal meta-analyses (Bücker et al., 2018; Huang, 2015), we expected a weak association between academic achievement and SWB. However, the relationship between adolescents' achievement motivation and SWB has not been investigated across many cultural/national samples. Thus, we did not have an informed prediction about this relationship. Third, anxiety is often seen as a component of SWB (Diener et al., 2002), and thus, its association with SWB is likely to manifest across different cultural/national groups. Thus, we expected that anxiety would be linked to SWB, possibly across different cultural groups. Last, empirical evidence for the associations between demographic variables (i.e., gender, SES, and immigration status) and SWB has been largely mixed (Ma & Huebner, 2008; OECD, 2020; Rodríguez et al., 2020), and thus, an informed assumption about the relationship between these demographic variables and SWB across different cultural groups is not feasible. Thus, it would be worthwhile to document potentially differential effects across a wide range of cultural/national groups.

4 Method

4.1 Data

We used data from the PISA 2015 Student Questionnaire (SQ), which assessed both academic and nonacademic outcomes of 15-year-old adolescents (OECD, 2017b). Among 72 countries that participated in PISA 2015, only 47 countries ($N=365,716$) completed the SWB item. Therefore, these 47 countries were included in our analysis. We organized 47 countries into world regions (see note in Table 1) according to the country classification of the Global Leadership and Organizational Behavior Effectiveness study (GLOBE; House et al., 2004). The GLOBE classification is established based on several psychological and cultural dimensions, such as in-group collectivism, gender egalitarianism, future orientation, and performance orientation (House et al., 2004). It is one of the most extensively employed country classifications (Hofstede, 1984; Stankov, 2010). Notably, the study by Jebb et al. (2020) also adopted the GLOBE classification to classify 166 countries to investigate the important predictors of SWB. Thus, we followed the same classification approach to provide a big picture of the global predictors of adolescents' SWB from 47 countries.

4.2 Measures

Subjective Well-Being (SWB). The PISA 2015 employed one item, "Overall, how satisfied are you with your life as a whole these days?", to measure students' SWB (OECD, 2017a). This item was provided with responses ranging from zero (not at all satisfied) to ten (completely satisfied). We created a binary variable of SWB (i.e., high and low). Individuals who showed an SWB score below the first quartile were defined as having low SWB, and those individuals who had an SWB score above the third quartile were defined as having high SWB.

Demographic Background. Gender, family SES, and immigration status were collected in PISA 2015 as the primary demographic background variables. Gender was coded with female as one and male as zero. The index of economic, social, and cultural status (ESCS) was employed as a family SES measure, with a scale mean of zero and a standard deviation of one. The ESCS was derived from the students' self-reporting of parental education, parental occupation, and home possessions (OECD, 2017a). The immigrant status variable was derived by students' self-reporting of the country of birth of their own and mothers and fathers (OECD, 2017a). Three categories of immigrant status were constructed in PISA: (a) native students who were born in the country and who had at least one parent who was born in the country, (b) second-generation students who were born in the country but who had both parents who were born in another country, and (c) first-generation students who were born outside of the country and who had parents who were also born in another country (OECD, 2017b).

Academic Achievement. Performance in science on the PISA 2015 was employed as a proxy for students' academic achievement. Science was the main subject domain in the PISA 2015, and it is known to be highly correlated with other domains in PISA (i.e., reading and mathematics; OECD 2017b). The science performance scale was

Table 1 Descriptive Statistics (Percentage, Mean, and Standard Deviation) for the Study Variables across GLOBE World Regions

Region	Percentage		Mean (S.D)									
	Female	First Generation	Second Generation	Fam- ily SES (ESCS)	Science Achievement	Achievement motivation (MOTIVAT)	Anxiety (ANXTEST)	Parent Support (EMOSUPS)	Teacher Support (TEACH-SUP)	Peer Sup- port (BE- LONG)	Sub- jective Well- being (SWB)	
1. Anglo (N=25,610)	49.30	9	9	0.16 (0.91)	502.84 (95.80)	0.52 (0.93)	0.20 (0.95)	0.16 (0.97)	0.21 (0.98)	-0.07 (0.95)	7.21 (2.23)	
2. Latin Europe (N=73,733)	49.80	6.8	4.7	-0.25 (1.07)	494.13 (94.28)	-0.17 (0.91)	0.25 (0.98)	0.06 (0.96)	0.00 (0.99)	0.18 (1.00)	7.35 (2.08)	
3. Nordic Europe (N=9,253)	49.90	2.5	1.5	0.49 (0.78)	501.98 (98.63)	-0.12 (1.09)	-0.26 (1.04)	0.10 (1.02)	0.25 (0.94)	0.14 (1.15)	7.84 (2.04)	
4. Germanic Europe(N=30,055)	49.40	9.20	17.3	0.12 (0.92)	500.20 (99.68)	-0.33 (0.92)	-0.31 (0.99)	0.19 (0.95)	-0.35 (0.97)	0.28 (1.08)	7.56 (2.04)	
5. Eastern Europe (N=75,737)	49.20	1.5	3.6	-0.15 (0.88)	478.37 (96.34)	-0.19 (0.91)	-0.08 (0.95)	-0.13 (0.97)	-0.10 (1.00)	-0.15 (0.93)	7.43 (2.29)	
6. Latin America (N=74,196)	50.90	0.90	1.1	-0.90 (1.16)	407.89 (85.79)	0.29 (0.86)	0.38 (0.88)	-0.01 (1.07)	0.39 (0.93)	-0.19 (1.06)	7.87 (2.32)	
7. Middle East (N=37,520)	50.80	18.80	9.9	-0.30 (1.31)	416.20 (88.77)	0.71 (0.99)	0.21 (0.98)	-0.10 (1.01)	0.22 (0.98)	-0.21 (0.95)	6.92 (2.77)	
8. Confucian Asia (N=39,612)	48.80	5.50	10.80	-0.46 (0.92)	526.03 (92.99)	-0.06 (0.98)	0.28 (0.96)	-0.43 (0.92)	-0.01 (0.91)	-0.16 (0.84)	6.61 (2.22)	

Note. Anglo group consists of: Ireland (N=5,741), United Kingdom (N=14,157), and United States of America (N=5,712); Latin Europe consists of: Belgium (N=9,651), France (N=6,108), Italy (N=11,583), Portugal (N=7325), and Spain^a (N=39,066). Nordic Europe group consists of: Finland (N=5,882) and Iceland (N=3,371); Germanic Europe group consists of: Austria (N=7,007), Germany (N=6,504), Luxembourg (N=5,299), Netherlands (N=5,385), and Switzerland (N=5,860). Eastern Europe consists of: Bulgaria (N=5,928), Croatia (N=5,809), Czech Republic (N=6,894), Estonia (N=5,587), Greece (N=5,532), Hungary (N=5,658), Latvia (N=4,869), Lithuania (N=6,525), Montenegro (N=5,665), Poland (N=4,478), Russia (N=6,036), Slovak Republic (N=6,350), and Slovenia (N=6,406). Latin America group consists of: Brazil (N=23,141), Chile (N=7,053), Colombia (N=11,795), Costa Rica (N=6,866), Dominican Republic (N=4,740), Mexico (N=7,568), Peru (N=6,971), and Uruguay (N=6,602). Middle East group consists of: Tunisia (N=5,375), Turkey (N=5,895), United Arab Emirates (N=14,167), and Qatar (N=12,083). Confucian Asian group consists of: China^b (N=9,841), Hong Kong (N=5,359), Japan (N=6,647), South Korea (N=5,581), Macao (N=4,476), and Taiwan (N=7,708). ^a Spain includes Spain (N=6,736) and Spain regions (N=3,2330). ^b China includes Peking, Shanghai, Jiangsu, Guangdong cities

constructed to have a mean of 500 and a standard deviation of 100 across the OECD countries¹(OECD, 2017b).

Secondary Disposition and Outcomes Relating to Schoolwork and Perceived Social Support. Student responses to the PISA SQ items were converted to the scaled scores using the IRT scaling procedure with the weighted likelihood estimate (WLE) (OECD, 2017b). We used the scale scores of the following five variables: (1) achievement motivation (MOTIVAT) to measure motivation in school; (2) anxiety for schoolwork and tests, as measured by the anxiety scale (ANXTEST); (3) students' perceptions of parental emotional support (EMOSUPS), (4) teacher support in science class (TEACHSUP), and (5) sense of belongingness with peers (BELONG) as the perceived social support from parents, teachers and peers, respectively. These scale scores were established with a mean of zero and a standard deviation of one across OECD countries. Thus, the scaled scores can be compared to the OECD average: a positive score indicated that it was greater than the OECD average, and a negative scale score indicated that it was lower than the OECD average. The scale scores are standardized with a normal distribution; approximately 68% of the scores fall within a range of -1 S.D. and +1 S.D., approximately 95% within a range of -2 S.D. and +2 S.D., and approximately 99% within a range of -3 S.D. and +3 S.D. The threshold values, presented in the DTM figures, should be interpreted with this standardized scale structure. All scales employed in this study had good internal consistency. The item descriptions and reliability are presented in Table B1 in Appendix B. The correlations among variables are in Table B2 (Appendix B).

4.3 Statistical Analyses

The main analysis of this study was carried out by a machine-learning approach, decision tree modeling (DTM), to identify the predictors and multiple pathways that lead to adolescents' SWB. In all our analyses, the nine variables introduced in the previous sections (i.e., demographic background, school-related disposition and achievement, and perceived social support) were employed as predictors to predict SWB.

DTM is a nonparametric model that does not require any statistical assumptions regarding data distribution and a statistical model. DTM takes the form of the classification and regression tree (CART; Breiman et al., 1984) procedures in which each tree is created via the recursive partitioning of the homogeneous feature space into the regions containing observations with similar characteristics concerning the outcome variable. Recursive partitioning is performed in such a way that the most important variable is selected as the first node to form statistically similar subgroups, after which the second most important variable is selected in the second node. Variables in the previous nodes could be reconsidered in each layer of the tree structure whereas unrelated variables are omitted. The partition ends when there are no more homogenous features that can be identified to classify the observations.

¹ The rotated incomplete assessment design was adopted in PISA where students answered some of the items from a booklet. Thus, ten plausible values were obtained from the item response theory (IRT) analysis to have a better estimate of students' performance (OECD, 2017b).

According to Berk (2006), Biau et al. (2008), and Strobl et al. (2009), the unique features of DTM concern its ability to: (a) generate multiple pathways to predict an outcome variable; (b) manage a large number of variables and include as many high-order interactions as required, which is a limitation in traditional parametric modeling; (c) automatically omit unrelated variables from the model; (d) include asymptotic and nonlinear relations and involve smoothing procedures to address hard-cut decision boundaries of nonlinear relations; (e) produce better prediction accuracy (compared to traditional parametric statistics) by taking the average of the estimates of the subsampling or bootstrap groups; (f) demonstrate the ranking of the predictors with respect to the importance to the outcome variable; and (g) utilize a tree structure for a demonstration of a model.

Therefore, DTM tree diagrams contain information about: (a) the tree structure, (b) variable importance among the predictor variables and which variables are omitted, (c) the number of splits, (d) identification of the most important variables that start the first split, (e) the threshold of each variable leading to the split, (f) complicated associations among multiple variables, (g) conditional probabilities belonging to the terminal nodes, and (h) the proportion of the observations in each of the terminal nodes. In the DTM results, the variable located in the first node (i.e., in the first row) in the tree structure is considered the most important variable for the criterion variable because all individuals must go through the first node before diverging into different pathways. Similarly, the variable(s) located in the last row are considered to be the least important, as the influence of those variables will be limited to a smaller subset of the sample. Note that the DTM is a recursive process in which a variable is reconsidered to be used as the predictor; thus, any variable can appear more than once in the tree structure.

Our final DTM outcome is the model prediction of the classification of individuals as having low or high SWB (i.e., SWB as a dichotomous variable). DTM produces information about accuracy, sensitivity, and specificity. Sensitivity is the true positive proportion, i.e., students with high levels of well-being were correctly classified into the high SWB group. Specificity is the true negative proportion, i.e., students with low levels of well-being were correctly classified into the low SWB group. Regarding accuracy, the correct number prediction (i.e., sensitivity and specificity) is divided by the total number of students.

We used the Gini impurity index (Therneau et al., 2019) to allow the algorithm to monitor impurity reduction via iterative partitioning. Following the common practice adopted in DTM, we divided 80% of the total data into the training dataset to identify the most suitable model and 20% of the data into the testing dataset for cross-validation of the model to assess whether the model exhibited similar results in training and testing data (James et al., 2014). Further details of DTM can be found in technical reports, e.g., Berk (2006), Biau et al. (2018), and Strobl et al. (2009).

We used the *rpart* package version 4.1.15 (Therneau et al., 2019) in the R 4.0.2 environment when analyzing the data using DTM. The *rpart* package removed cases in which part of the response was missing (Therneau et al., 2019).

5 Results

5.1 Descriptive Statistics

Table 1 presents descriptive statistics of the study variables. The proportions of gender were equally distributed within each of the cultural regions. Most students were native to their countries, although variations across the cultural regions were noted. On the family SES scale (ESCS), Nordic Europe had the highest score of family SES ($M=0.49$), while Latin America had the lowest score ($M=-0.90$). Confucian Asia had the highest science achievement score ($M=526.03$), while Latin America had the lowest score ($M=407.89$). The Middle East had the highest level of achievement motivation ($M=0.71$), while Germanic Europe had the lowest ($M=-0.33$). Latin America had the highest level of anxiety ($M=0.38$), and Germanic Europe had the lowest level of anxiety ($M=-0.33$). Germanic Europe had the highest levels of parent support ($M=0.19$) and peer support ($M=0.28$) but the lowest level of teacher support ($M=-0.35$) compared to the other parts of the world regions. The highest level of teacher support was found in Latin America ($M=0.39$). Confucian Asia had the lowest level of parent support ($M=-0.43$). The Middle East had the lowest level of peer support ($M=-0.21$). Finally, Latin America had the highest level of SWB ($M=7.87$) along with Nordic Europe ($M=7.84$), and Confucian Asia showed the lowest SWB ($M=6.61$).

5.2 Decision Tree Modeling (DTM) Results

Overall, the accuracy of our DTM results across the eight regions was acceptable: the mean of accuracy index was 0.73 ($SD=0.05$, $Max=0.79$, $Min=0.67$) in the training data and the mean of accuracy index was 0.73 ($SD=0.05$, $Max=0.79$, $Min=0.66$) in the testing data. The details of the accuracy, sensitivity, and specificity estimates of each region are provided in Table B3 (see Appendix B) along with the DTM analysis procedure description provided in Appendix A.

The DTM results are presented in Figs. 1, 2, 3, 4, 5, 6, 7 and 8, which are arranged from a simple structure (e.g., Latin America) to a complex structure (e.g., Anglo). As described in the Method section, achievement was normally distributed with a mean of 500 and an SD of 100, and the other seven scale-level variables (except for gender and immigrant status) were normally distributed with a mean of zero and an SD of one. Thus, the cutoff numbers presented in the figure should be interpreted with the scale values of each variable. The final outcome in the DTM model is displayed in the final nodes (boxes) to illustrate the model prediction (i.e., conditional probability) of the classification of the students to either a low or high SWB group. We used Fig. 1 (Latin America) as an example to illustrate the numbers in the tree.

In Fig. 1, there are three types of numbers in the DTM final outcome. The first is a threshold number that splits the sample to a different path. For example, the threshold score on the parental support scale that divides the sample was 0.72 in the first node. Similarly, this threshold score on achievement was a score of 401 (see Fig. 1). Then, the conditional probabilities to classify the sample of students into a low or high SWB group are presented in the final nodes/box. On the far-left node, a sample

student classified to have parental support lower than 0.72 and achievement greater than 401 had a conditional probability of 0.75 of being in a low SWB group and a conditional probability of 0.25 of being in a high SWB group. Given these probabilities of 0.75 vs. 0.25, these students are predicted to have a low SWB. The percentage in the final node, 37% in the far-left node in Fig. 1, indicates the proportion of the student sample who belong to this low SWB group. In summary, the model outcome can be described as follows: students who perceived that their parent support was 0.72 or below and with an achievement score of 401 or higher had a probability of 0.75 of being classified into the low SWB group. In the sample of Latin America, 37% of students are characterized by this pathway, which leads to a low SWB group.

In the following sections, we organized the results in three sections: (a) the results showing the simple DTM structures: Latin America (Fig. 1), Latin Europe (Fig. 2), and Confucian Asia (Fig. 3); (b) the results showing the slightly more complex DTM structures: Eastern Europe (Fig. 4) and Middle East (Fig. 5); and (c) the results showing the most complex DTM structure: Anglo (Fig. 6), Nordic Europe (Fig. 7) and Germanic Europe (Fig. 8).

5.3 Simple Structure with the First Split Starting from Parent Support

Latin America (Fig. 1), Latin Europe (Fig. 2), and Confucian Asia (Fig. 3) showed simpler DTM structures with fewer nodes and fewer splits compared to other world regions. Their first split variable was parent support (see Figs. 1, 2 and 3). The simplest structure was found in Latin America (Fig. 1). Only two variables were relevant to adolescents' SWB in this region: (1) parent support and (2) academic achievement. The three splits created four different ways of predicting adolescents' SWB.

Two main pathways classified 70% of the sample into either a low (37%) or high (33%) SWB group. Those who perceived their parent support to be greater than or equal to a threshold of 0.72 (on a scale with a mean of zero and an SD of one across the OECD countries) were directly classified into the high SWB group (33%). On the other hand, those with perceived parent support of lower than 0.72 and achievement scores greater than 401 were predicted to be in the low SWB group (37%). Those whose achievement scores were lower than 401 were split into two additional groups: (1) those with parent support between -0.044 and 0.72 were expected to have high SWB (11%), and (2) those with parent support lower than -0.044 were expected to have low SWB (19%). As seen in these four different pathways to lead to SWB, parent support was the most critical predictor of adolescents' SWB in this region. In contrast, academic achievement was the second most important predictor while playing a small role in the prediction of SWB.

Latin Europe had a similar structure as Latin America (Fig. 2). However, in addition to parent support, peer support and gender were found to be relevant to the classification prediction of adolescents' SWB in this region. Parent support was the most important variable, as was the case for Latin America, because it was the first decision split node and as many as 66% of the Latin European adolescents were classified to have a low SWB based on information about parent support alone (i.e., lower than a threshold of 0.52). However, to be classified as the high SWB group, adolescents in Latin Europe were characterized by parent and peer support. Specifi-

cally, adolescents with parent support greater than or equal to 0.52 and peer support greater than or equal to 0.65 were classified as being in the high SWB group (16%). For the remaining adolescents, gender was important to their SWB in addition to parent and peer support. When perceived parent support was greater than or equal to 0.52 and peer support was 0.65 or lower, boys were likely to be in the high SWB group (8%). However, if peer support was lower than 0.65, then girls were likely to experience low SWB (10%).

Confucian Asia (Fig. 3) showed another fairly simple structure. For this group, all three (parental, peer, and teacher) social support variables were important contributors to SWB. The majority of the Confucian Asian sample was classified to have a low SWB (48%; see the left-right node) or a high SWB (21%; see the far-right node). For these two pathways, only parent and peer support variables were important contributors to SWB (with relevant threshold values of -0.071 , -0.018 , and -0.16 ; see Fig. 3). The remaining adolescents in the sample were further classified with additional information on their parent support (with a threshold of -1) and teacher support (with a threshold of -0.064). It is interesting to note that an additional 9% of the sample of Confucian Asian adolescents were classified to have high SWB with teacher support (greater than -0.064) if they also had parent support greater than or equal to -0.071 and peer support lower than -0.16 (see Fig. 3). Thus, there was a small portion of Confucian Asian adolescents (9%) in which teacher support served as a buffering role even if they felt insufficient support from parents or peers.

5.4 Slightly More Complex Structure with First Split Starting Parent Support

Eastern Europe (Fig. 4) and the Middle East (Fig. 5) demonstrated slightly more complex structures than Latin America, Latin Europe, and Confucian Asia. Similar to Latin America, Latin Europe, and Confucian Asia, the first split was parent support. Additionally, similar to Confucian Asia and Latin Europe, peer support was the next important variable in both Eastern Europe (Fig. 4) and the Middle East (Fig. 5). Similar to Latin Europe, gender was the third and least important variable in Eastern Europe.

In the Eastern Europe sample, 52% were classified as having low SWB (see the far-left path) based on the information from only two variables: (1) parental support (with a threshold of lower than 0.24), and (2) peer support (with a threshold of lower than 0.20). Another 15% was classified as being in a high SWB group (see the far-right path); for these students, parent support was greater than or equal to 0.24 and peer support was greater than or equal to 0.11. These findings indicated that information from only two variables (parent support and peer support) could determine the majority of the adolescents' (52% + 15%) pathways to either a low or high SWB group. For the remaining sample, 30% (i.e., 6% + 7% + 9% + 8%) of adolescents were linked to gender as the final variable to decide SWB. Among them, both low SWB groups (6% and 9%) consisted of female students in addition to the paths relating to parent support and peer support. Overall, parent support, peer support, and gender contributed to adolescents' SWB in Eastern Europe.

The Middle Eastern group (Fig. 5) showed a complexity level similar to that of Eastern Europe, with six splits and seven different pathways leading to SWB. In

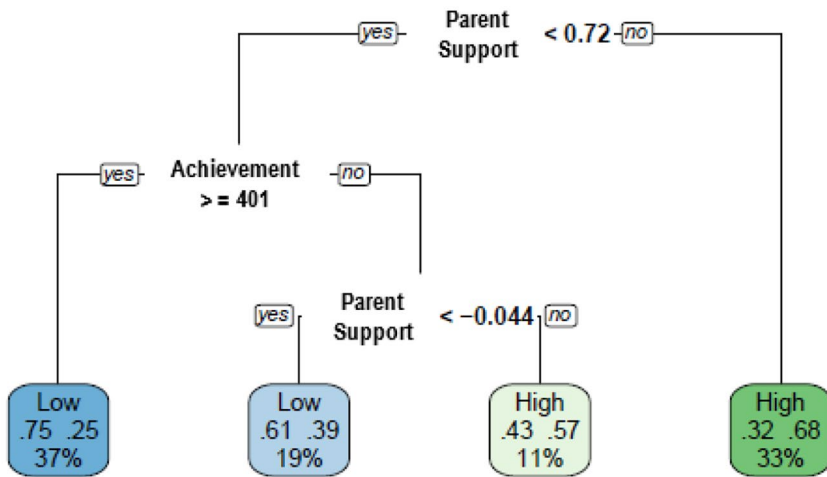


Fig. 1 Decision-Tree Model Predicting SWB: Latin America (N=74,196)

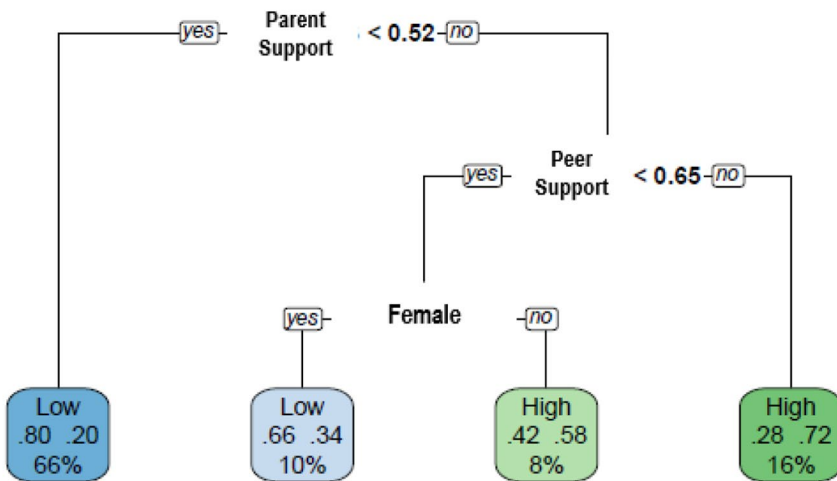


Fig. 2 Decision-Tree Model Predicting SWB: Latin Europe (N=73,733)

addition to parent and peer support, anxiety, achievement, and teacher support were also important for Middle Eastern adolescents' SWB. As was the case in other world regions described above, parent and peer support were the dominant sources of SWB because 77% of students (19% + 21% + 37%; see the three terminal nodes in two far-left and one far-right sides) were predicted to have either low or high SWB based on the information on these two variables. The remaining sample of adolescents (i.e.,

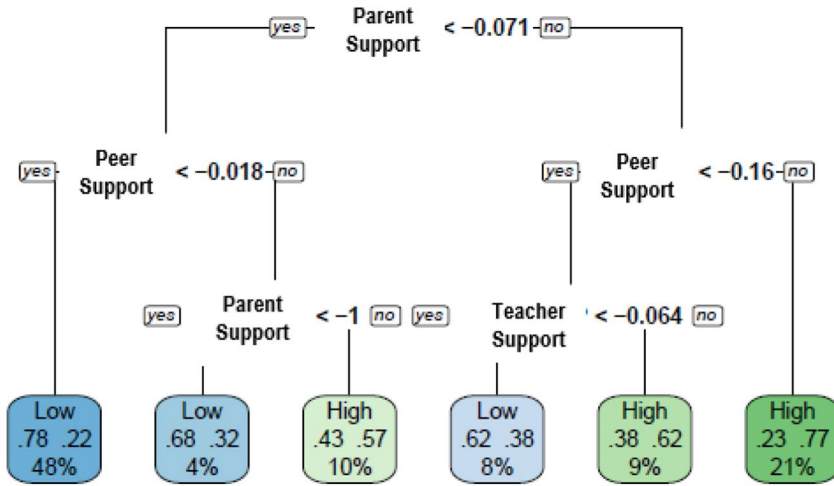


Fig. 3 Decision-Tree Model Predicting SWB: Confucian Asia (N=39,612)

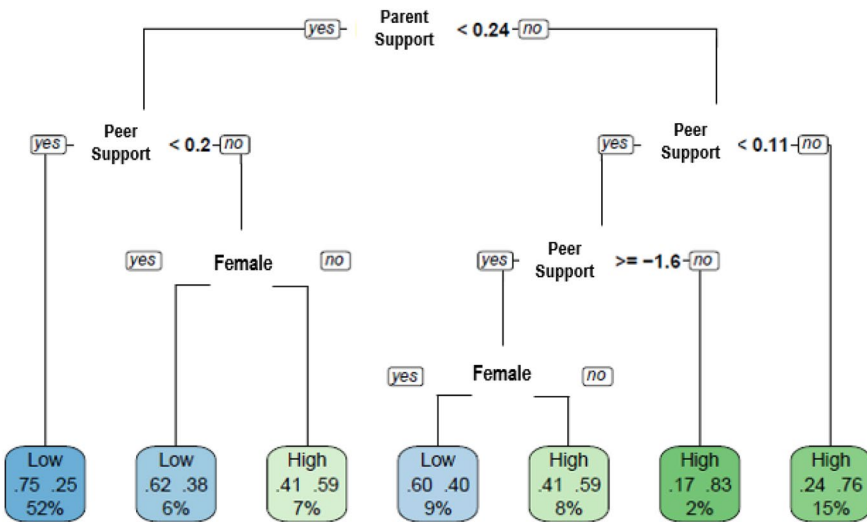


Fig. 4 Decision-Tree Model Predicting SWB: Eastern Europe (N=75,737)

24% from 7% + 5% + 6% + 6%) was associated with the links between anxiety, achievement, and teacher support with SWB. For instance, approximately 6% of Middle Eastern adolescents in the sample were classified as having high SWB when they had teacher support greater than or equal to 0.37 along with achievement scores lower than 429, anxiety greater than -0.42, peer support greater than -0.41 and par-

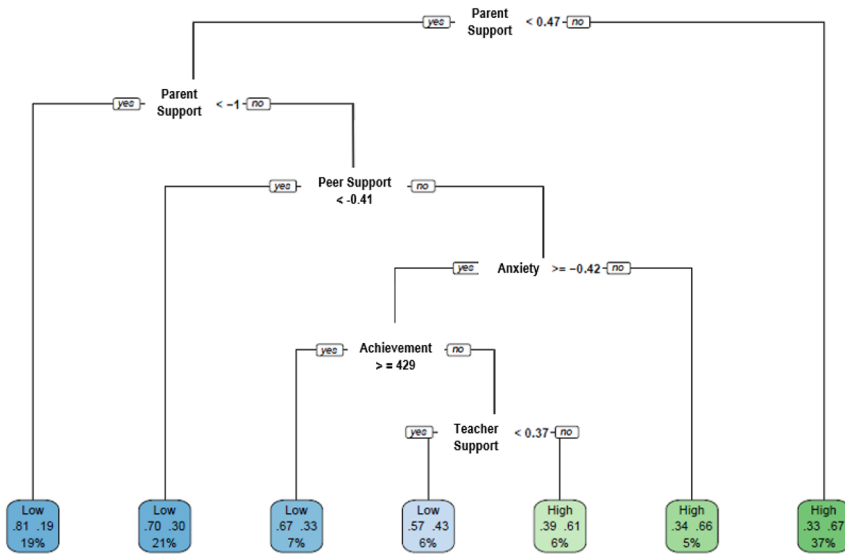


Fig. 5 Decision-Tree Model Predicting SWB: Middle East (N=37,520)

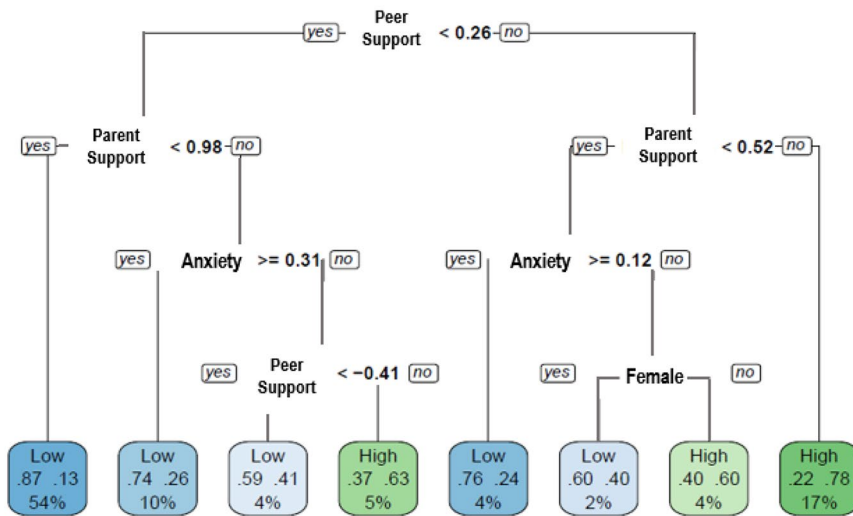


Fig. 6 Decision-Tree Model Predicting SWB: Anglo (N=25,610)

ent support between -1 and 0.47 . Note that the scales were standardized, with 99% of the values falling within the range of -3 and $+3$) except for achievement scores.

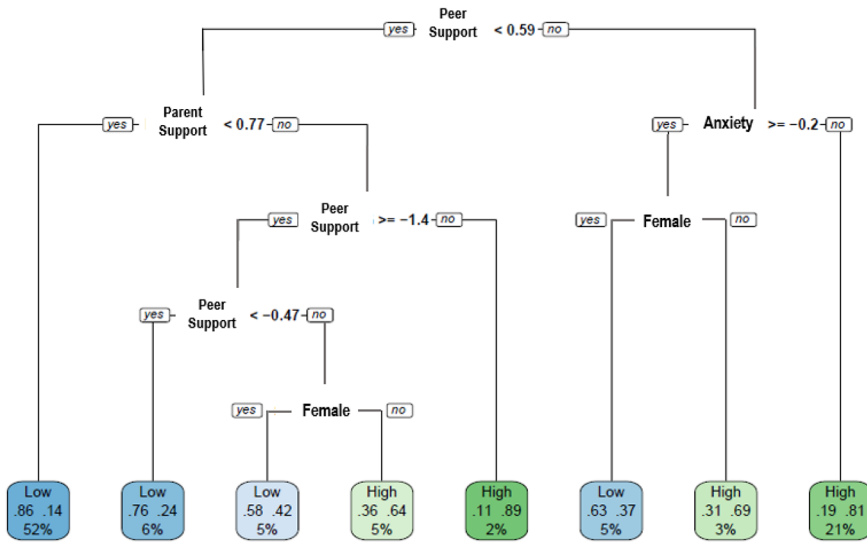


Fig. 7 Decision-Tree Model Predicting SWB: Nordic Europe (N=9,253)

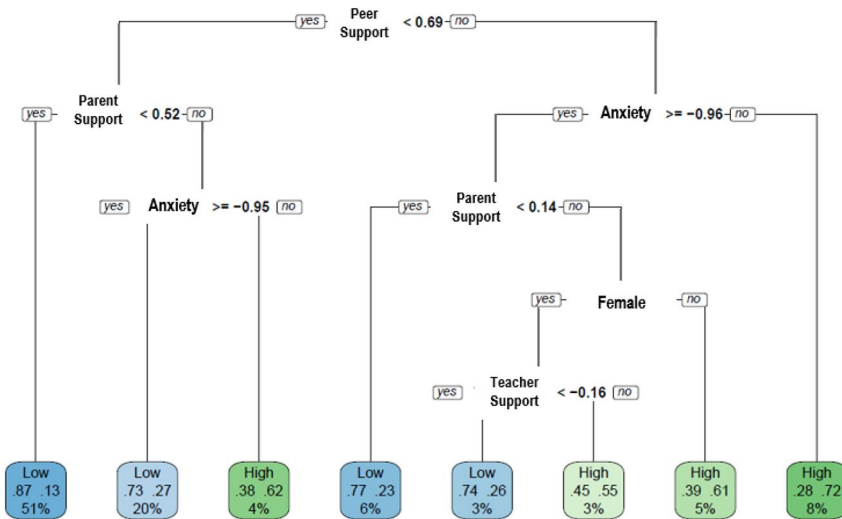


Fig. 8 Decision-Tree Model Predicting SWB: Germanic Europe (N=30,055)

5.5 The Most Complex Structure with the First Split Starting from Peer Support

Anglo (Fig. 6), Nordic Europe (Fig. 7) and Germanic Europe (Fig. 8) showed the most complex tree structure with eight decision tree outcomes (i.e., eight final nodes

and seven splits). Unlike the other five world regions (Figs. 1, 2, 3, 4 and 5), these three world regions had peer support as their first split. In the Anglo group (Fig. 6), although peer support was the first split node, it was immediately linked to parental support. As shown in Fig. 6, peer support alone could not determine adolescents' SWB, and additional information about parent support was needed. Based on only these two variables (peer support and parent support), the majority of the Anglo sample (54% + 17%; see the far-left and far-right nodes) were classified as having either low or high SWB. Next, anxiety seemed to play an important role, and the remaining sample (10% + 4% + 5% + 4% + 2% + 4%) had anxiety in their pathways to SWB. On the other hand, only 6% (2% + 4%) of them were linked to gender in predicting SWB.

Like the Anglo group, peer support was the first split in Nordic Europe (Fig. 7). However, again, information from peer support and parent support classified as much as 52% of adolescents into a low SWB group. Anxiety seemed to play a role as well as it was linked to nearly 30% (see three far-left nodes, 5% + 3% + 21%). Based on peer support and anxiety, 21% of adolescents' SWB classification was made by the model (see the far-right node). Altogether, parental support, peer support, and anxiety assigned most Nordic European adolescents to either a low or high SWB group. The exception was the subgroups that were linked to gender (5% + 5% + 5% + 3%; see Fig. 7). As seen in the final nodes linked to gender in Fig. 7, conditional on the information on the other variables in the model, girls were predicted to have low SWB, and boys were predicted to have high SWB. However, among the important variables included in the model, gender played the least important role as it was linked to only 18% of the sample.

In Germanic Europe (Fig. 8), peer support, parent support, and anxiety were the three most salient variables to the SWB classification, similar to the DTM results of Anglo (Fig. 6) and Nordic Europe (Fig. 7). As many as 79% of the Germanic European adolescents were classified into having either low or high SWB based on just these three variables. In addition, gender was linked to SWB for 11% (3% + 3% + 5%) of the sample. Among these proportions, 6% (3% + 3%) required teacher support to be used in the prediction of SWB. Thus, for Germanic Europe, Anglo, and Nordic Europe, peer support was the most important variable for SWB, while parental support and anxiety were also important. The role of gender was also important but played a much smaller role in adolescents' SWB.

5.6 Summary of DTM Results

Table 2 summarizes all DTM results concerning the variables of importance to SWB. Parent support and peer support were the most salient variables for adolescents' SWB across the eight world regions. Anxiety was also important for the Middle East, Anglo, and Nordic and Germanic Europe. Gender was an important variable for SWB of adolescents in all four European regions (Latin, Eastern, Nordic, and Germanic Europe) along with Anglo. Teacher support was important for only three regions: Confucian Asia, the Middle East, and Germanic Europe. Academic achievement was important only for Latin America and the Middle East. It is also noteworthy that there was no single world region in which achievement motivation, immigration

Table 2 Rank-Order of Variable Importance based on the decision tree modeling (DTM) Results

Variable	Latin America	Latin Europe	Confucian Asia	Eastern Europe	Middle East	Anglo	Nordic Europe	Germanic Europe
Parent support	1	1	1	1	1	2	2	2
Peer support	-	2	2	2	2	1	1	1
Anxiety	-	-	-	-	3	3	3	3
Gender	-	3	-	3	-	4	4	4
Teacher support	-	-	3	-	5	-	-	5
Achievement	2	-	-	-	4	-	-	-

Notes. Numbers indicate the rank-order of the variable importance in the decision tree models. Variables that were omitted in the decision tree modeling (i.e., immigration status, family SES, and academic motivation) were not included in the table. —represents the variables were omitted as they were deemed not important in the decision tree modeling

status, and family SES were important variables for adolescents' SWB. Overall, the DTM results showed that parental support and peer support were the most salient and globally relevant predictors of SWB across all eight world regions.

6 Discussion

Despite the importance of subjective well-being (SWB) in adolescents' achievement and development into adulthood (van Ryzin et al., 2009; Walsh et al., 2010), little is known about its relevant predictors across different world regions. Based on the social-cognitive-behavior model of academic predictors of adolescents' life satisfaction (SCB; Suldo et al., 2008) and self-determination theory (SDT; Ryan & Deci, 2000) frameworks, we investigated nine school-related social, cognitive, and behavioral factors that are organized into three subgroups: (a) perceived social support from parents, peers, and teachers, (b) academic achievement, academic motivation, and schoolwork-related anxiety (i.e., secondary disposition and outcomes relating to schoolwork), and (c) gender, family SES, and immigration status (i.e., primary demographic background variables). We used the decision tree modeling (DTM) technique to examine how these variables interacted with each other and identify the pathways leading to SWB.

Our results demonstrated similarities and differences in the predictors of and pathways leading to SWB across the eight world regions. The most enlightening and perhaps unexpected findings were consistent results indicating the importance of parent and peer support for adolescents' SWB (see the summary table, Table 2). Parent support was the most or second most salient predictor of SWB across all eight world regions. Peer support was the most or second most salient predictor of SWB across seven world regions except for Latin America. Overall, the DTM results identified these two variables to be the most salient and universally applicable predictors of SWB. Reflecting on the SCB model and SDT, these findings provide empirical support for social connections being critical predictors of adolescents' SWB.

Within these globally consistent results, we note some variations: in five regions (Latin America, Latin Europe, Confucian Asia, Eastern Europe, and the Middle East)

parental support was the most important variable, while in the other three regions (Anglo, Nordic Europe, and Germanic Europe) peer support was the most important variable. Furthermore, no identical tree structure was found across the eight regions; there were unique pathways to SWB for adolescents in different parts of the world. Cross-regional variations were also found in the less salient but still important variables: anxiety, gender, teacher support, and achievement. They were included in the tree modeling in some but not all regions (see Table 2).

6.1 Parent Support and Peer Support as the Most Salient Predictors of Adolescents' SWB

Although the importance of social support for SWB has been abundantly emphasized in previous studies (Kocayörük et al., 2015; Suldo et al., 2009; Virtanen et al., 2019), the relative salience of social support from parents, peers, or teachers to adolescents' SWB has been less clearly understood. Our study demonstrated compelling evidence about this relative importance by examining adolescents' SWB across eight world regions. Our results supported our initial expectation that social support would be the strongest predictor of adolescents' SWB. Our results also clarified that parent support was the most important variable in Latin America, Latin Europe, Confucian Asia, Eastern Europe, and the Middle East, while peer support was the most important variable in Anglo, Nordic Europe, and Germanic Europe. However, given the full tree structures, it is evident that peer support alone could not determine adolescents' SWB in these three regions. The link of peer support was immediately connected to parent support and anxiety. These latter two variables were then directly linked to SWB for the majority of adolescents across these three regions. Furthermore, our DTM in most world regions (i.e., Confucian Asia, Middle East, Anglo, Nordic Europe and Germanic Europe) showed that parent support could serve as a buffer against the adverse effects on SWB and can lead to a high level of SWB even if perceived peer support was not ideal. Our Anglo results (i.e., Ireland, the United Kingdom, and the United States of America) contradicted Lawler et al. (2017), who found that parental support was more critical to life satisfaction than peer support. However, their samples were limited to six midwestern states in the United States. In alignment with Lawler et al. (2017), our results suggest that the importance of parental support could not be underestimated in SWB prediction even in the three regions where peer support was positioned to be the first split node.

From the development perspective, it is known that adolescents' desire to gain autonomy and independence from adult figures is one of their critical developmental tasks (Eccles et al., 1993; Gutman & Eccles, 2007). Their desire to achieve psychological detachment from parents indicates a diminished parental role and increased perceived importance of peers and other social relationships during adolescence (Lansford, 2018; Ma & Huebner, 2008). However, the degrees of the perceived importance of social relationships with parents or peers might be influenced by culture (Buchmann & Kriesi, 2011; Markus & Kitayama, 1991). A cross-cultural study by Schwarz et al. (2012) comparing 11 countries (i.e., China, France, Germany, India, Indonesia, Israel, Poland, Russia, South Africa, Turkey, and the US) found that cultural groups with a heavy emphasis on family duties and family values (e.g., India, South Africa)

showed a weakened effect of peer acceptance on the prediction of young adolescents' life satisfaction compared with cultural groups with less emphasis on family-related values (e.g., France, Germany, and the United States). Cultures advocating individualism and less focus on family-oriented values can also promote the development of independence and self (House et al., 2004) because young adolescents might shift their social priorities from parents to peers when searching for self-identification and building social relationships with others. These ideas were reflected in our results, where peer support was highlighted as the most important variable in the cultural groups of Anglo, Nordic Europe, and Germanic Europe, which tend to score highly on individualism (House et al., 2004).

6.2 Anxiety and Gender as Relevant Predictors of Adolescents' SWB

As Diener et al. (2002) defined that the judgment of SWB involves cognitive, negative, and positive affective evaluations, our initial expectation was that adolescents' SWB would be linked to schoolwork-related anxiety. This was partially supported in that our DTM results demonstrated the importance of anxiety for SWB only in four regions: the Middle East, Anglo, Nordic Europe, and Germanic Europe. Furthermore, anxiety was not found to be the first split variable in any region of these regions and is more likely to be located in the lower part of the tree structure. This means that the effect of anxiety on adolescents' SWB could be enhanced or mitigated by the other variables in the model (i.e., those that preceded anxiety in the tree structure, which are parent support or peer support). Our model suggests that those who perceive a sufficient level of parent or peer support can avoid anxiety to kick in to play a role in their SWB, as suggested in the stress-buffering hypothesis in Cohen and Wills (1985).

Our model also showed that gender was relevant to SWB in only five regions: four European regions (Latin, Eastern, Nordic, and Germanic) and Anglo. Previous research findings on the role of gender on SWB have been mixed. The Better Life Initiative by OECD (OECD, 2020) and Huebner (2004) demonstrated a negligible gender gap in life satisfaction. While our study demonstrated the relevance of gender in Europe and Anglo groups, we illustrated the interactions of gender and other variables in the DTM findings. In other words, the relationship between gender and SWB was not simple in any of these cultural groups, which implies that no conclusion can be drawn about whether girls or boys are more or less satisfied with life. Given the location and importance of the gender variable in the DTM structure (third or fourth in rank-order, see Table 2), the effect of gender on SWB was conditional on the effects of other variables in the model on SWB. As was the case for anxiety, gender was also directly linked to either parent support or peer support in the tree structures of all regions where gender was found to be important. This means that, like anxiety, the role of gender on SWB was conditional on parental support or peer support for adolescents' SWB. In addition, gender was also linked to anxiety in Nordic Europe and Germanic Europe. Thus, the interactions among parent support, peer support, and anxiety are associated with SWB among girls. As suggested in the World Happiness Report (Helliwell et al., 2020) and Else-Quest et al. (2010), gender-related issues may be not about the gender itself but gender-related social-economic phenomena

such as gender equality in the workplace (e.g., % of higher labor market position held by women, see Else-Quest et al., 2010) or perceived gender equality (Helliwell et al., 2020). Inclusion of such gender-related variables may provide a better understanding of the role that gender plays in SWB across different world regions.

6.3 Teacher Support and Achievement as Weak Predictors of Adolescents' SWB

Past research has viewed student-teacher relationships as important for students' developments of a sense of purpose in learning and feelings of relatedness in the school environment and for school and overall life satisfaction (Cattley, 2004; Collie et al., 2016; Lee, 2021; Suldo et al., 2008; Suldo et al., 2009). However, our DTM analysis showed that adolescents' perceived teacher support was important only in three regions: Confucian Asia, Eastern Europe, and Germanic Europe, and its importance in the tree modeling structure was quite low (see Table 2). Overall, our modeling did not suggest that teacher support is critical to adolescents' perception of SWB when other relevant factors were included in the analyses. Lawler et al. (2017) also noted the low salience of teacher support in comparison to parental or family support for adolescents' SWB. Another school-related variable, academic achievement, was also not important in most regions. Only Latin America and the Middle East showed links between academic achievement and SWB in our DTM. Although SDT posits that a sense of autonomy, relatedness, and competence are likely to contribute to SWB, our analysis demonstrated that academic achievement was not associated with adolescents' SWB when other factors were considered in the model. Nevertheless, academic achievement may be indirectly linked to adolescents' SWB via other school-related processes and outcomes that are related to domain-specific competence and confidence (Stankov et al., 2014). Future research may adopt other achievement-related variables, such as self-efficacy and self-concept, as potential mediators or moderators of the achievement-SWB relationship.

6.4 Family SES and Immigration Status Not Related to Adolescents' SWB

In the initial stages of our variable selection and model building process, we employed a set of potentially important variables for adolescents' SWB. Our findings showed that family SES and immigration status were not relevant predictors of adolescents' SWB in any region when other important indicators (i.e., parent and peer support) were considered in the model. Family SES is known to be a positive enabler of children's social-emotional development both inside and outside of the home (Lee et al., 2019; Somerville & Whitebread, 2019), a positive enabler of better physical health (Sweeting & Hunt, 2014), and a lower risk of mental illness (Zou et al., 2020). However, family SES was not linked to adolescents' SWB in any of the world regions that we examined. Immigration status was also a surprising result given the mixed results in the extant literature, such as lower SWB of immigrant students compared to their native peers in Finland (Liebkind & Jasinskaja-Lahti, 2000) and Portugal (Neto, 2001) and no difference in Canada (Berry & Hou, 2017), Spain (Rodríguez et al., 2020) and Italy (Alivernini et al., 2020). Our study revealed that immigration

status did not emerge as an important variable for adolescents' SWB in any of the eight regions when the model included other variables.

7 Limitations of This Study

It is worth noting several limitations of the current study. First, although DTM is an advanced statistical method, it is not a causal model. Thus, we did not imply any causality in our findings. Second, our data relied on self-reported information. There is some unknown level of response bias in any self-report questionnaire data. Future studies may adopt multiple raters to validate students' perceptions of social support and well-being. Third, although we considered many relevant school-related variables to predict well-being, other potentially relevant predictors, such as personality (Lucas, 2018) and interest in life and schoolwork (Lee & Durksen, 2018), were not included in this study. Thus, future studies could include these relevant variables to extend our understanding of important predictors of well-being in young adolescent samples. Fourth, our modeling did not include macro-level and contextual variables such as the nation's economic development or societal values, regulation, and conventions, which might influence subjective well-being judgment. Finally, to the best of our knowledge, the current machine learning analyses, including DTM, are not designed to incorporate complex survey sampling features, such as the use of all available plausible values or student weights (Gabriel et al., 2018). However, our unit of analysis is at the regional level, and thus, student weights that are designed to produce a nationally representative sample would not be relevant to our analysis.

8 Conclusion and Practical Implications

Using decision tree analyses, the present study extends the current knowledge about how adolescents' SWB may be construed by the complex interactions of their perceived social relationships with parents and peers, school-related psychological dispositions such as anxiety, and demographic variables such as gender. Our DTM also revealed multiple pathways to lead to SWB among adolescents within and across regions. Thus, the one-size-fits-all approach that is often implied in intervention studies may not be appropriate to promote SWB in different parts of the world.

Our findings provide specific recommendations and practical implications for educators, policy-makers, and health professionals in different regions. We suggest that early interventions to monitor, regulate, and assist the network of social support might prove to be important for adolescent well-being. If adolescents perceive an insufficient level of parental support, then well-established peer support could compensate in Latin America, Latin Europe, Confucian Asia, Eastern Europe, and the Middle East. Thus, teachers and school communities can develop more extracurricular activities to strengthen social ties among peers. On the other hand, when adolescents perceive an insufficient level of peer support, parental support could serve as a buffer from negative impacts in Anglo, Nordic Europe, and Germanic Europe. In such cases, teachers and school communities may strengthen direct communication

with parents. As such, our modeling delineating the different pathways that lead to SWB contains useful suggestions for designing a range of SWB interventions that are tailed to specific needs and characteristics at the individual and regional levels.

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Declarations

Conflict of interest We do not have any conflicts of interest to declare.

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