Longitudinal associations between positive attributes and psychopathology and their interactive effects on educational outcomes

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Authors' contributions

Ms. Romani-Sponchiado, Dr. Salum and Dr. Hoffmann led the study at all stages and drafted the manuscript. Ms. Romani-Sponchiado and Dr. Hoffmann designed and did the analyses. Drs. Bressan, Mari, Miguel, Gadelha, Rohde and Salum developed and conducted the Brazilian High-Risk cohort data collection. Drs Vidal-Ribas and Evans-Lacko provided substantial contributions to interpretation of data and critically revised the paper for important intellectual content. All authors helped interpret the analyses and critically reviewed and revised the report for intellectual content and approved the final version. Everyone who meets the criteria is included as an author.

Abstract

Psychopathology is associated with impaired learning and early termination of schooling, whereas positive attributes are associated with better educational outcomes. However, it is important to understand if and how psychopathology and positive attributes longitudinally impact each other so we could shed light on where to intervene to promote educational outcomes through these constructs. A large prospective school-based community cohort of youths (5-15 years of age, 45% female) were assessed and followed up for 3 years (n=2,010; 80% retention). We assessed the longitudinal impact of positive attributes (Youth Strength Inventory) and psychopathology (bifactor model of Strengths and Difficulties Questionnaire) using a cross-lagged panel model. We also used generalized mixed effects models to investigate how these both constructs predict school dropout and literacy, adjusting for confounders and testing their interaction. Positive attributes negatively predicted, and were negatively predicted by, the general factor of psychopathology and conduct problems in the cross-lagged panel model. Positive attributes (OR = 0.57, 95% CI [0.44, 0.73], $p < 0.001$) and specific conduct symptoms (OR = 2.33, 95% CI [1.64, 3.33], $p < 0.001$) predicted school dropout, whereas the general factor of psychopathology predicted lower literacy ability ($\beta = -0.08$, 95% CI [-0.11, -0.05], $p < 0.001$). However, the protective association of positive attributes on school dropout decreases as the general factor of psychopathology increases. These findings provide new evidence that positive attributes and psychopathology mutually influence each other over development and have interactive effects on educational outcomes.

Keywords: socioemotional skills; non-cognitive skills; mental health; child psychiatry; literacy; school dropout.

Introduction

Educational attainment and achievement in childhood and adolescence are associated with future earnings, social adjustment, health and overall mortality [1]. Education is also influenced by mental health conditions [2–4], and positive attributes, defined as desirable behavioral traits (e.g., being generous and responsible) [5–9]. Although research has begun to examine the role of psychopathology and positive attributes on education outcomes, major questions remain.

First, there is still debate on how positive attributes and psychopathology influence each other over development. This is a first step towards understanding additive and interactive associations between them and education. Positive attributes are fundamentally positive behavioural traits, composed by items such as being affectionate, responsible, persistent, generous, or eager to learn, which are key components of socioemotional skills [7,9,10]. These skills are potentially modifiable and key to counteract deleterious effects of early disadvantages and mental health problems [6,7,9,10]. Positive attributes in childhood and adolescence are associated with less risk of future mental health conditions and internalizing and externalizing psychopathology [9,11,12]. However, it is unclear whether these longitudinal associations between positive attributes and both domains of psychopathology are mainly due to their shared aspects (the general factor of psychopathology, the "p-factor") or due to specific variance, i.e., specific internalizing and externalizing aspects, as emotional, conduct or inattention/hyperactivity symptom dimensions.

The YSI is a section (N) of the Development and Well-Being Assessment (DAWBA) [13] which was developed to collect information on youth's strengths. This subscale asks about descriptions on a set of behaviours that forms the construct of positive attributes (e.g., reliable, responsible, interested in many things and independent). To investigate the associations between positive attributes and psychopathology, Vidal-Ribas and colleagues [11] tested the psychometric properties of the Youth Strength Inventory (YSI) and found that a single-factor explained between 79% and 83% of items' variance at baseline and follow-up. The authors found that positive attributes can predict later psychiatric disorders in healthy children 36 months later, beyond predictions based on baseline psychiatric symptoms [11]. Also, Hoffmann and colleagues [8] showed YSI are empirically discriminable from psychiatric symptoms (SDQc) through a confirmatory factor analysis (CFA), meaning that YSI and SDQc are distinct constructs, despite correlated [8].

Second, it is important to understand whether dimensional psychopathology (both general, and specific conduct, emotional, and inattention/hyperactivity symptom dimensions) and positive attributes can

potentiate or cancel each other's effects on educational outcomes, although previous literature on this issue do not consider the differentiation between general and specific factors when testing associations. Such understanding can reveal, for example, if the association of psychopathology with school dropout depends on the level of positive attributes [8]. In that sense, if positive attributes modulate the effects of psychopathology on educational outcomes, interventions targeting the promotion of positive attributes [14] might have effects on educational outcomes by buffering the negative effects of psychopathology on such outcomes and vice versa.

The aim of this study was to address these gaps by, first, testing whether, both general and specific symptom dimensions of psychopathology, and positive attributes impact each other across time and, second, by examining the main and interactive effects on educational attainment and learning. Data from a large prospective school-based community cohort [15] were used to evaluate positive attributes and psychopathology at baseline and a 3-year follow-up. First, we investigate longitudinal associations between general and specific symptom dimensions of psychopathology and positive attributes using cross-lagged panel model (CLPM). We hypothesize that positive attributes will have a negative association with all dimensions of psychopathology after 3 years. Second, the impact of general and specific symptom dimensions of psychopathology and positive attributes, as well as their interaction, on educational outcomes were tested using generalized mixed effects models, adjusted for confounders. We hypothesize that psychopathology will be associated with higher dropout rates and lower literacy, whereas positive attributes will be associated with the same outcomes in the opposite direction. In addition, positive attributes will interact with psychopathology, in a way that higher levels of positive attributes will buffer the impact of psychopathology dimensions on dropout and poor literacy.

Methods

Participants

Data were obtained from the Brazilian High Risk Cohort (BHRC) study for Psychiatric Disorders [15]. This school-based community cohort aimed to investigate developmental trajectories of psychopathology and mental disorders through a two-stage design - screening and assessment phases. At screening phase, all parents presented at state-funded schools in São Paulo (n=35) and Porto Alegre (n=22) on school

registration days (compulsory in Brazil) were invited to participate. All state-funded schools with more than 1000 students in the age of interest were invited to participate in the study. Participation in all phases of the study was voluntary and written consent and assent were obtained from the caregivers and youths, respectively. Verbal informed consent and assent were obtained from parents and youths who were unable to read or write. Of those approached, 8,012 caregivers (87.3% mothers) accepted to be interviewed with a modified version of the Family History Screen [16] conducted by lay interviewers, with the purpose to estimate family risk for psychiatric diagnosis [15]. Two subgroups were recruited from a total of 9,997 screened subjects: a random subsample (n=957) and a high-risk sub-sample (n=1,554). These subjects (N=2,511) were selected for full assessment.

We analysed data collected at baseline (2010-2011) and at 3-year follow-up (2013-2014). At baseline, 2,511 youth (5 to 15 years of age, 45% female) and their caregivers were interviewed. The 3-year follow-up comprised 2,010 participants (80% retention; 9-17 years of age, 44% female). Follow-up participation was associated with higher maternal education and socioeconomic status, living in Porto Alegre, and anxiety-related disorders at baseline.

Ethical Considerations

This study was approved by the ethics committee of the University of São Paulo [IORG0004884/National Council of Health Registry number (CONEP): 15.457/Project IRB registration number: 1132/08] and has been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Measures

Positive Attributes Positive attributes was measured with the Youth Strength Inventory (YSI), a subscale (section N) of the Development and Well-Being Assessment (DAWBA) [11,13]. It is a 24-item scale divided into two blocks of 12 questions each and caregivers respond how applicable descriptions are to the child as “No”, “A little”, or “A lot”. The first block assesses child characteristics (e.g., lively, easy going, grateful, responsible) and the second block assess actions that please others (e.g., helps around the home, well behaved, keeps bedroom tidy). YSI factor scores was extracted from a confirmatory factor analysis

model (CFA) and Cronbach's alpha was 0.946 (See supplementary material page 1 and Table A1 for details).

Psychopathology (general and specific symptom dimensions) Child and adolescent psychopathology was assessed with the Strengths and Difficulties Questionnaire (SDQ) [14], a 25-item parent-report questionnaire with five subscales of five items each that provides scores of emotional, inattention/hyperactivity, conduct and peer relationships problems and prosocial behaviour. Responses were given as "Not true", "Somewhat true" and "Certainly true" on how each attribute applied to the child. For the purposes of this study, we included emotional, inattention/hyperactivity and conduct problems, considering the overlap of peer relationship problems and prosocial behaviour with positive attributes. These 15 questions were modelled in CFA as a bifactor model [17], which included an overarching general psychopathology factor (loading in all 15 items) and three residual orthogonal specific psychopathology factors (emotional, conduct and inattention/hyperactivity). SDQ general and specific factor scores were extracted from the CFA and Cronbach's alphas were 0.889 for general factor, 0.766 for emotional subscale, 0.808 for conduct subscale and 0.839 for inattention/hyperactivity subscale. Reliability coefficient omega of general factor were 0.734, and hierarchical omegas were 0.373 for emotional subscale, 0.176 for conduct subscale and 0.001 for inattention/hyperactivity subscale (See supplementary material page 1 and Table A2 for details).

Educational Outcomes

Literacy This evaluation comprised abilities of reading and writing measured by the School Performance Test ("Teste de Desempenho Escolar" - TDE) [18]. The test is composed of two right/wrong subtests of reading (12 items) and writing (61 items). A unidimensional model of reading and writing items was fitted using CFA. Factor scores from this model were extracted and used as the literacy ability outcome (See supplementary material page 1 for details).

School Dropout Caregivers reported information related to expulsion and dropout at baseline and follow-up using a retrospective life history chart, by asking parents "Did your child drop out of school (since last

data collection)?" and "Has your child been expelled from school (since last data collection)?". For this study, dropout and expulsion were grouped together into one binary variable (yes vs no): school dropout.

Covariates

Race/ethnicity Participants were grouped into one of five categories: White/Caucasian, Asian, Black, Mixed races, and Indigenous. For analytical purposes, race/ethnicity was grouped as White or non-White.

Social class Social class was assessed using the classification from the "Associação Brasileira de Empresas de Pesquisa" and categorized as A/B (wealthiest); C (middle class) and D/E (lowest social class) [19] (see supplementary material page 3 for details). The proportion of children in each economic classification criteria is similar to what is encountered in the instrument's standardization from cities from which the sample was recruited [20].

Maternal education Maternal education was reported at baseline and categorized in four groups indicating complete educational level, from none to complete tertiary education (see supplementary material page 3 for details).

Maternal psychopathology We used the Mini International Psychiatric Interview (MINI) and the MINI Plus [21,22] to assess the presence of any maternal history of psychiatric disorders (see supplementary material page 3 for details).

Intelligence quotient (IQ) IQ estimate was made through vocabulary and block design subtests of the Wechsler Intelligence Scale for Children, 3rd edition [23], applying Brazilian norms [24] standardized by age and sex [25]. For the purposes of this study, IQ z-score was used.

Statistical Analysis

To test our first hypothesis, we used CLPM to test if there was a cross-lagged longitudinal association between positive attributes (YSI) and psychopathology (general and specific symptom dimensions) (SDQ) over time using package "*lavaan*" [26] in R software [27]. For this study, CLPM was conducted using structural equation modelling (SEM), considering YSI an unidimensional model and SDQ as a bifactor model as previously mentioned. SEM is interpreted considering goodness of fit of each separate model and the overall SEM fit [28]. We used comparative fit index (CFI) ≥ 0.95, the Tucker–Lewis index (TLI) ≥ 0.95,

and the root mean square error of approximation (RMSEA) ≤ 0.06 as acceptable indices of model fit [29]. CLPM associations are interpreted as residualized change after the autoregressive effects is accounted [30].

To examine our second hypothesis, we estimated linear (literacy outcome) and logistic (dropout outcome) mixed effects models with random intercepts (clustered by schools at baseline). We conducted a sequence of hierarchical models, beginning with an autoregressive model (i.e., outcome at follow-up predicted by outcome at baseline) which all models were built upon. After this, we added variables to estimate 1) the independent and additive association of YSI and SDQ factors on the educational outcomes; 2) the association of YSI or SDQ factors alongside covariates and 3) the interaction of YSI with all SDQ factors in a fully adjusted model. For the first step, we included either YSI or each SDQ factor at a time (5 independent models – univariate models), following by the inclusion of all SDQ factors and YSI simultaneously. For the second step, we added a block of covariates (age, sex, race/ethnicity, IQ, social class, and maternal education and psychopathology) in a model containing YSI or SDQ factors. For the third step, a final model was estimated by adding all SDQ factors and YSI simultaneously plus their respective interaction term plus the block of covariates (fully adjusted model). All the above-mentioned linear and logistic regression models were adjusted for missing at follow-up and for high-risk sampling of this cohort using inverse probability weight (IPW) and sampling weights respectively (See supplementary material page 2 for details).

Results

Factor models and sample description between baseline and follow-up

Factor models accounting for both time-points for positive attributes (YSI), multidimensional psychopathology (general and specific) (SDQ bifactor model), and literacy ability, fitted the data well and generated reliable factors (See supplementary material page 4 and Tables A1 and A2 for details). Table 1 describes the demographic characteristics of the sample, considering both baseline and follow-up, comprising all variables of interest of the study. Participants were divided almost equally between young male and female, being predominantly middle social class (C) and white.

{Table 1 around here}

Longitudinal associations of positive attributes and psychopathology

Figure 1 depicts the longitudinal associations between positive attributes, and general and specific psychopathology dimensions. Positive attributes were associated with lower levels of general psychopathology (SDQ-general) at 3-year follow-up. Baseline general psychopathology was associated with lower levels of positive attributes three years later (Figure 1, Panel A).

Regarding specific dimensions of psychopathology, higher levels of baseline positive attributes were associated with lower levels of conduct and inattention/hyperactivity symptom dimensions at 3-year follow-up. At the same time, higher levels of baseline conduct symptoms were associated with lower levels of positive attributes. In contrast inattention/hyperactivity and emotional symptoms were not longitudinally associated with positive attributes (Table A3).

{Figure 1 around here}

Association of positive attributes and psychopathology with educational outcomes

In the bivariate models, higher levels of positive attributes were associated with both better literacy scores and lower dropout rates. However, the association between positive attributes and literacy was fully explained by the general and specific psychopathology dimensions, whereas the associations with dropout were still significant even after adjusting for potential confounders, including psychopathology (Table 2).

In the bivariate models, higher levels of general psychopathology were associated with lower literacy scores and higher dropout rates. However, the association between general psychopathology and dropout rates was fully explained by co-occurring positive attributes in the model; in contrast, the association between general psychopathology and literacy was still significant even after adjusting for potential confounders, including positive attributes. Higher levels of conduct symptoms, but not inattention/hyperactivity and emotional symptoms, were associated with higher dropout rates in all models. All regression models can be found in Table A5 (literacy outcome) and A6 (school dropout outcome), in which it can be observed the increments in marginal and conditional explained variance of adding variables and blocks of variables (Table 2).

{Table 2 around here}

Moreover, interactions were found between positive attributes and general psychopathology in relation to school dropout at follow-up in the fully adjusted model (Table 2). This means that the association of the general factor of psychopathology and positive attributes depends on the level of each other whereas predicting chances of school dropout. We estimated marginal effect analysis to understand this interaction (Figure 2). The results showed that increasing 1SD of positive attributes score is associated with lower chances of school dropout only for individuals with lower levels of psychopathology (SDQ-general factor score < 0.0, Figure 2). Thus, the strength of the association between positive attributes and school dropout weakened as a function of increasing levels of psychopathology. For example, at a factor score of −1.5 of general psychopathology, an increase of one standardized unit of score in positive attributes reduces the OR to school dropout to 0.31 (95% CI [0.14, 0.68], p = 0.004); however, this effect is not seen at a score of 0.0 of general psychopathology (Figure 2 and Table A4).

{Figure 2 around here}

Discussion

This study aimed to investigate whether positive attributes and psychopathology (general and specific symptom dimensions) had long-term impact on each other and whether they had interactive effects in the prediction of literacy ability and school dropout. Confirming our initial hypothesis, general and specific psychopathology dimensions and positive attributes were associated across time, providing evidence of the intertwined relationship of these constructs across development. We found prominent negative impact of general psychopathology and conduct symptoms specifically on positive attributes, but also of positive attributes conferring lower general psychopathology and conduct symptoms over time, mutually influencing each other. Our second hypothesis was that positive attributes would be associated with better literacy ability and low dropout rates, and the opposite would be for psychopathology. Interestingly we found independent negative association between positive attributes and dropout, and independent positive association between psychopathology and literacy ability. Moreover, we showed that positive attributes

were associated with lower rates of school dropout only if the individuals presented lower levels of general psychopathology.

Mental health has a major impact on future life chances [31–34]. Early positive aspects of functioning might be prone to change and be trained throughout development. This can predict better job opportunities, lower substance use and lower criminality as much as well-being in the adult life [14,33,35]. At the same time, early psychopathology can reduce the likelihood of better life outcomes; it is therefore cost-effective to intervene early on this risk factor [31,34,36]. Furthermore, this mechanism might be happening early on, with psychopathology and positive attributes having opposite effects on the promotion of early education, which is key to foster life chances [1]. Studies on interventions focusing in develop skills related to positive attributes in any moment of development demonstrate improvements in a range of socioeconomic outcomes and reduce future psychopathology [14,36–39]. These interventions also present to be effective even when applied in a disadvantaged environment. The Perry Preschool Project (PPP) and the Abecedarian Project (ABC) are projects which aimed to assign enriched environments to children at risk (e.g., mother/father with low educational level or IQ ≤ 90, low family income, social agencies in the community indicate the family needs assistance). Investigations on long-term impact of interventions presented significant effects on general health and socioeconomic status via positive behavior [14]. Similar results are found in a low-cost intervention aiming to teach growth mindset, gratitude, and value affirmation to adolescents in Kenya. Participants were selected by presence of elevated symptoms on standardized depression or anxiety measures and a significant reduction of symptoms were demonstrated at the end of the intervention [39]. Here we extended previous findings on the distinction between positive attributes and psychopathology by showing the negative cross-lagged longitudinal association between these two mental health constructs.

Previous observational and experimental findings have demonstrated that positive attributes have negative longitudinal associations with mental health conditions, including externalizing and internalizing symptoms [9,11]. Here we demonstrated that this relationship might be due to a negative impact of positive attributes on the general factor of psychopathology and conduct specific factor, and similarly, these psychopathology dimensions at baseline are negatively associated with positive attributes three years later. It is important to underscore that the general factor explains variance from all symptomatic domains, including emotional and inattention/hyperactivity symptoms. This general domain explains most of the associations with positive attributes, which suggests this association is not due to a particular set of

symptoms, but to overall mental health problems which are shared among all symptomatic domains. After parsing out variance due to this common factor, the conduct score still explained additional variability in positive attributes, which suggests the associations between conducts specific factor and positive attributes might be due to other mechanisms not shared with the common factors such as genetic overlap with poor verbal and spatial reasoning, verbal knowledge, and general cognitive ability [40], for example. Previous research has found bidirectional associations between positive attributes and both internalizing and externalizing disorders, especially the latter [11]. However, the authors did not parse out the variance into general and specific domains of psychopathology, as we did in the current study. It is possible that this difference in methodological approach might explain why we did not find associations with emotional symptom domains after removing the variance explained by a general factor of psychopathology. Our findings encourage to examine whether interventions aiming at reducing general psychopathology in childhood and early adolescence can prevent the reduction of positive attributes in early to late adolescence. The same is valid for specific conduct problems. This can be key to promote better mental health and future life chances that depend upon these positive skills [7,32,36,41]. Nonetheless, caution should also be taken when interpreting the positive association between positive attributes and inattention/hyperactivity symptoms, since this construct presented small and some negative factor loadings, conferring it little reliability.

Nonetheless, positive attributes are associated with reduced rates of dropout only if the general factor of psychopathology is low. Previous literature have demonstrated that positive attributes interact with cognitive skills as well as with psychopathology to promote better educational outcomes [5,6,8,42] in a way that the association of positive attributes depends on the level of psychopathology. Therefore, the levels of psychopathology should be lowered in order to positive attributes can have a positive impact on school dropout. This reinforces the argument for the prevention and early intervention of mental illness to promote positive attributes and mental well-being [31,32]. This is also important if we consider that most children and adolescents do not have a mental health condition [43] and therefore, are ready to receive interventions to increase such positive skills.

Findings of this study must be understood in the light of some limitations. First, although this is a longitudinal study, we only had data from a short follow-up. A longer follow-up period would enhance the long-term impact of the results. However, this time window can reveal the early mechanism of future outcomes. Second, observational studies are not appropriate for causal conclusions, as they may not

incorporate all risk factors to explain the causality chain. However, we analysed our data using adjustment for confounders and autoregressive effects to enhance the potential for experimental interests. Third, psychopathology and positive attributes measurement considered one source of information only (parents), as well as the school dropout outcome. However, parents are widely used as a reliable source of information for these constructs in childhood and adolescence [44] and the constructs are only mildly correlated in our CLPM, which reinforce their measurement independence. Future research on this issue is encouraged to include other sources of information, such as self, teachers and peers, and approaches to assess the variables. Fourth, expulsion and dropping out of school can be circumvented, respectively, by the child being enrolled in another school that accepts it and by the child's decision/condition to return to school at a future time. Therefore, our results do not inform definitive evasion, but is an indicator of serious problems in the individual's educational course, which is a known risk factor for low attainment and educational poverty.

Conclusions

This study provides new evidence on the relationship of positive attributes and dimensional psychopathology, considering their interplay and the longitudinal impact on each other and educational outcomes. Our results suggest that the general factor of psychopathology and specific conduct symptoms negatively predicts, and are negatively predicted by, positive attributes. Therefore, it is demonstrated that the relationship between general and specific dimensions of psychopathology are linked with positive attributes. Also, these associations are through general and conduct dimensions, proposing a new perspective on the previous literature on internalizing dimensions from correlated models which do not account the general factor [11]. Nonetheless, as a mechanism by which this construct impact later life, we found that the general factor of psychopathology is negatively associated with literacy ability, while school dropout is positively predicted by specific conduct symptoms and negatively predicted by positive attributes. Furthermore, interaction analysis reveal that positive attributes predict low school dropout only if general psychopathology is low. Previous evidence on socioemotional skills could be read with different lenses after these finding, in a sense that only promoting these skills is not enough to enables better life chances, which would also require screening and treating mental health problems to enable socioemotional skills to have an impact on school dropout. These findings also encourage trials on positive attributes

promotion to prevent psychopathology as much as prevention and treatment of psychopathology to promote positive attributes in children and adolescents.

Ethical standards

This study was approved by the ethics committee of the University of São Paulo [IORG0004884/National Council of Health Registry number (CONEP): 15.457/Project IRB registration number: 1132/08] and has been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. Participation in all phases of the study was voluntary and written consent and assent were obtained from the caregivers and youths, respectively. Verbal informed consent and assent were obtained from parents and youths who were unable to read or write.

Conflict of interest

PVR, JJM, ECM, SEL declare that they have no competing or potential conflicts of interest in relation to this work. ARS is supported by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES; Brazilian Federal Foundation for Support and Evaluation of Graduate Education; grant number 88882.346693/2019-01). RAB has been a consultant and/or advisor to or has received honoraria from: Pfizer, Torrent and Sanofi-Aventis. AG has been a consultant and/or advisor to or has received honoraria from: Janssen, Aché, Daiichi-Sankyo, Cristália and Torrent in the last three years. LAR has been a consultant and/or advisor to or has received honoraria from: Novartis/Sandoz and Shire/Takeda in the last three years. The ADHD and Juvenile Bipolar Disorder Outpatient Programs chaired by LAR have received unrestricted educational and research support from the following pharmaceutical companies in the last three years: Novartis/Sandoz and Shire/Takeda. LAR has received authorship royalties from Oxford Press and ArtMed and travel grants from Shire to take part in the 2018 APA annual meeting. GAS is supported by the US National Institute of Mental Health (grant number R01MH120482). MSH is supported by the research grant of the Brazilian Ministry of Health under the "Termo De Execução Descentralizada - TED 12/2019", the US National Institute of Mental Health (grant number R01MH120482) and by the Newton International Fellowship (Ref: NIF\R1\181942), awarded by the Academy of Medical Sciences through the UK Government's Newton Fund Programme.

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Availability of data and material

Data is available upon request in the *Open Science Framework* public repository (https://osf.io/ktz5h/) and syntax to process raw variables used in this study can also be found in *gitlab* (https://gitlab.com/bhrc/bhrc).

Code availability

Code is available upon request to the corresponding author.

Consent for publication

The manuscript final version and publication is approved by all authors.

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Fig 1 Cross-lagged panel model of longitudinal associations of positive attributes and general and specific psychopathology factors

[Figure 1]

Note: β, standardized regression coefficient; CI, 95% confidence interval; R^2, total variance explained on the outcome; YSI, youth strength inventory derived from confirmatory factor analysis; SDQ, strength and difficulties questionnaire general factor extracted from confirmatory factor analysis. *, $p<0.05$; **, $p<0.01$; ***, $p<0.001$.

Fig 2 Interaction and marginal effects of positive attributes for fixed values of the general factor of psychopathology on the probability of school dropout

[Figure 2]

Note: (A) The y-axis represents the OR to school dropout by deciles of the general factor of psychopathology (x-axis) and YSI (z-axis); (B) The y-axis represents the OR to school dropout depending on the average marginal effect of increasing 1 SDQ-general z score (black dots with 95% CI) conditioned on increasing levels of YSI z scores (x-axis). OR, odds ratio; CI, confidence interval; SDQ, Strength and Difficulties Questionnaire; YSI, Youth Strengths Inventory.