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Pediatrics and Neonatology xxx (xxxx) xxx

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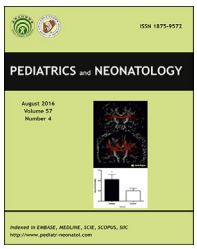

Original Article

Adolescent developmental assets and longitudinal weight status and psychosocial health outcomes: Exploratory analysis from a youth cohort study in Taiwan

Meng-Che Tsai [a,*,1], Jennifer M.T. Ng [b,1], Yi-Fang Yu [c], Carol Strong [c], Yi-Ping Hsieh [d], Yi-Ching Lin [e], Chung-Ying Lin [b,f]

[a] *Department of Pediatrics, National Cheng Kung University Hospital, College of Medicine, National Cheng Kung University, Tainan, Taiwan*
[b] *Department of Rehabilitation Sciences, Faculty of Health and Social Sciences, Hong Kong Polytechnic University, Kowloon, Hong Kong*
[c] *Department of Public Health, National Cheng Kung University Hospital, College of Medicine, National Cheng Kung University, Tainan, Taiwan*
[d] *Department of Social Work, College of Nursing and Professional Disciplines, University of North Dakota, Grand Forks, ND, USA*
[e] *Department of Early Childhood and Family Education, College of Education, National Taipei University of Education, Taipei, Taiwan*
[f] *Institute of Allied Health Sciences, College of Medicine, National Cheng Kung University, Tainan, Taiwan*

Received Dec 3, 2020; received in revised form Mar 15, 2021; accepted May 17, 2021
Available online ■ ■ ■

Key Words
Adolescent developmental assets;
Psychosocial health;
Weight status

Backgrounds: Asset-based youth development has been proposed to be associated with health behaviors and psychological well-being in adolescents. This study aims to extend the current knowledge regarding the effects of positive youth development on weight status and psychosocial health outcomes in young adulthood using a large representative longitudinal sample.
Methods: Data were retrieved from the Taiwan Youth Project that comprised a longitudinal cohort of adolescents (N = 2688) surveyed at grades 7, 8, 9, and 12, and at age 22. Principal component analysis was used to construct developmental asset scores based on 35 items selected from the relevant questions at wave 1. Outcomes were standardized scores of body mass index, self-rated healthiness and happiness, depressive symptomology and deviant behaviors in the subsequent waves. Generalized estimating equation analysis was applied to

* Corresponding author. Department of Pediatrics, National Cheng-Kung University Hospital, College of Medicine, National Cheng Kung University, 138 Sheng-Li Road, Tainan, Taiwan, 704.
E-mail address: ache93@yahoo.com.tw (M.-C. Tsai).
[1] Tsai MC and Ng JMT should be considered joint first authors.

https://doi.org/10.1016/j.pedneo.2021.05.006
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Please cite this article as: M.-C. Tsai, J.M.T. Ng, Y.-F. Yu et al., Adolescent developmental assets and longitudinal weight status and psychosocial health outcomes: Exploratory analysis from a youth cohort study in Taiwan, Pediatrics and Neonatology, https://doi.org/10.1016/j.pedneo.2021.05.006

assess the impact of developmental assets on these repeatedly measured outcome variables. *Results:* As compared to those with the highest quintile level of developmental assets, individuals with the lowest quintile level were more likely to rate themselves unhealthy ($\beta = 0.33$ [95% confidence interval 0.26, 0.40]) and unhappy ($\beta = 0.47$ [0.41, 0.54]) and report more depressive symptomatology ($\beta = 4.18$ [3.35, 5.01]) and deviant behaviors ($\beta = 0.63$ [0.44, 0.81]). No association was found between body mass index and developmental asset scores. *Conclusion:* The results concluded a longitudinal association between adolescent developmental assets and psychological and behavioral health outcomes. Further research may be required to investigate whether positive youth development could be translated into long-term benefits in adult physical conditions, such as obesity.
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1. Introduction

Adolescence has a long-standing reputation as a period filled with rebelliousness, thus making it a challenging stage to manage. A recent research paradigm, however, shifts from the prior problem-based approaches to those recognizing the complexity of youth development trajectories, where physical, psychological, social and emotional maturations occur and interact.[1] The *positive youth development* (PYD) theory posits that youth tend to modify their childhood trajectories toward healthy adulthood by developing social and interpersonal competency to withstand adversity when their assets are aligned with their environment.[2,3] Developmental assets conceptually are an agglomeration of personal and contextual factors, broadly categorized into internal and external factors, pertaining to children and adolescents.[4] Internal factors usually refer to an individual's characteristics or social links to surrounding people, while external factors include environmental factors that may shape the development in youth. Multiple cross-sectional studies have found the association between adolescent developmental assets, mental wellbeing, and health-compromising behaviors, such as substance use, risky sex behaviors, delinquency and fighting.[3,5–7]

Previous literature has summarized a myriad of social determinants of youth health at personal, family, and community levels, as these factors are highly interactive at this stage of life.[8] The way these social determinants affect youth health is overlapping with the framework of positive youth development that focuses on the empowerment among the socially under-sourced youth. Corresponding to this notion, accumulative developmental assets contribute to multi-faceted protection against negative outcomes including depression, risk behaviors, and sexually transmitted diseases.[9,10] Despite growing evidence of the association between youth developmental assets and outcomes, few studies extend these cross-sectional findings to longitudinal effects in young adulthood. For instance, Hoyt at al found that positive wellbeing during adolescence was associated with better perceived general health and fewer risky health behaviors during young adulthood.[7] Another study led by Bleck and DeBate also identified a significant pathway linking developmental assets to tobacco and alcohol use, nutrition, and physical activity.[11] An active lifestyle has long been recognized as a protective factor of obesity and metabolic diseases. However, there is no prior evidence of a relationship between developmental assets and body weight status, except for some cross-sectional studies with focus on the population with eating disorders.[12] How adolescent developmental assets have effects on weight status, which is related to several physical conditions in adulthood, remains unclear, and this gap in knowledge should be filled.

This study aimed to expand the current knowledge regarding the effect of PYD on the longitudinal physical and psychosocial outcomes from adolescence to young adulthood. Specifically, it was attempted to identify a set of developmental assets and examine its association with self-rated health and happiness, depressive symptomatology, deviant behaviors, and weight status in a representative sample of Taiwanese youth.

2. Methods

2.1. Study population

Data for analysis were retrieved from a longitudinal panel study by the Taiwan Youth Project (TYP), which sampled a nationally representative cohort of 7th- and 9th-grader students using a multistage-stratified and class-clustered selection procedure and surveyed them annually from 2000 up to the present.[13] The participants were recruited from three regions in northern Taiwan and a total of 81 classes distributed across 40 schools were finally chosen (Taipei City: 16 schools; New Taipei City [called Taipei County before 2010]: 15 schools; Yilan County: 9 schools). A subset ($n = 2688$) of data on the 7th graders in the beginning of study was analyzed because the variables of interests were available for the entire adolescence until young adulthood (wave 9 at age 21–22). The current study retrieved the data from waves 1 (7th grade), 2 (8th grade), 3 (9th grade), 6 (12 grade), and 9, for the purpose of constructing exposure (wave 1) and outcome (waves 1, 2, 3, 6, and 9)

variables. The procedure was approved by the institutional review board of National Cheng Kung University Hospital.

3. Measures

3.1. Youth developmental asset scale

There is, as yet, no consensus on a strict construct of youth developmental assets. Based on a developmental framework proposed previously,[3,6] a total of 45 items that were relevant and available in the TYP dataset were initially included. The authors from the background of developmental psychology, adolescent medicine and public health evaluated the appropriateness of these items. A total of 10 items were excluded due to duplication and irrelevance based on agreement among the panel of experts. In order to reduce the dimensionality of the selected items, principal component analysis (PCA) was used to extract the factors that were therefore named as follows.[14]

3.1.1. Support
The selected items represented the level of support received by adolescents included family and friend networking.[15,16] These items, such as "whether they received comfort from other family members when frustrated" and "whether classmates gave a hand when needed", were answered in a 4-point Likert scale.

3.1.2. Boundaries and disciplines
The items representing family boundaries were exemplified by parental practices such as setting and executing family rules, knowing their children's whereabouts, and relationship and attitudes regarding their children's friends.[17]

3.1.3. School bonding
The subscale included items such as "whether you liked the school", "whether you felt belonging to the school", and "whether you were proud of the school". This construct has been validated as an indicator representing school commitment.[17,18]

3.1.4. Positive identity
Self-esteem was assessed using three items on positive feelings that were initially adopted from the Rosenberg Self—Esteem Scale and had been validated for measuring adolescent self-esteem in this local context.[15]

3.1.5. Positive values
The relevant items included "trustworthy", "considerate", "get along with others", "responsible", "modest", and "friendly".[19] These questions were all phrased in one's relations with others in the interaction, which is highly valued and aligned with Taiwanese social values.[19]

3.1.6. Social relationship
The construct of interpersonal relationships described an overall profile of ties with parents, teachers and peers.[15,20]

3.2. Outcome variables

3.2.1. Weight status
Based on self-reported values, body mass index (BMI) was calculated and operated as proxy of weight status. Further, the BMI values were standardized within the same-age-and-sex population to obtain standardized BMI scores (BMI-SDS).[21]

3.2.2. Self-rated health
Self-rated health is a subjective evaluation of his/her collective health status and has become a useful assessment of perceived healthiness.[22] The participants were asked to rate their general health status in a 5-point scale from 1 (very good) to 5 (very poor).

3.2.3. Self-rated happiness
Self-rated happiness is a subjective appreciation of life, which can also serve as an indicator of the overall well-being in the population study.[22] Likewise, the participants were asked to rate their recent feelings toward life in a 4 point-scale from 1 (very happy) to 4 (very unhappy).

3.2.4. Depressive symptomatology
Psychological well-being was measured using the validated Chinese version of the Center for Epidemiologic Studies Depression (CES-D) scale.[15] This scale comprises 16 major physical and psychological symptoms that are usually experienced among depressive adolescents in Taiwan. A 5-point Likert's scale from 1 to 5 was used to score these items and all the item scores were then summed up, so that the higher the score, the more the respondent is psychologically troubled.

3.2.5. Deviant behaviors
Deviant behaviors, which participants were asked to report on for the previous year, included "breaking items", "cigarette smoking", "alcohol drinking", "stealing", "being involved in physical fights", "drag racing", and "using illicit drugs". Responses were rated using a 5-point Likert's scale from 1 (never) to 5 (always) and then summed up create a single scale which indicates the degree of behavioral problems. These behaviors were assessed only at waves 1, 2, 6, and 9.

3.3. Covariates

Gender, living area, family income, and parental education at wave 1 were included as covariates in the analysis. The father's or mother's highest education attainment, according to the length of educational years, was used as one indicator of socioeconomic status for the study sample.

3.4. Statistical analysis

3.4.1. Principal component analysis of adolescent developmental asset scale
Ratings of each item were subjected to an exploratory factor analysis using the principal axis method with the varimax rotation to extract factors.[14] The number of factors was determined according to the eigenvalues >1, while the cut-off value for rotated factor loading was set at 0.5.

Based on the coefficient matrix, scores for each component factor were summed up to create an overall score that reflected the amplitude of developmental assets.[14] In order to examine the external validity, correlation analysis was carried out between the component factor and overall scores with cross-sectional self-rated health and happiness, psycho-behavioral outcomes, and weight status at wave 1 using Pearson correlation analysis.

3.4.2. Longitudinal association with developmental outcomes

As the variables of self-rated happiness and health status, depressive symptomatology, problematic behaviors, and BMI-SDS were repeatedly measured over the period of study (across multiple waves 1, 2, 3, 6, and 9), generalized estimating equation (GEE) analysis was conducted to examine the temporal effect of adolescent developmental assets (assessed at wave 1) on the developmental outcomes of interest. Further, the participants were regrouped according to the scores on the youth developmental asset scale into 5 quintile categories with the first quintile representing those having the highest level of youth developmental assets. Referenced to the first quintile, the regression analysis calculated the relative correlative coefficients for the developmental outcomes of interest in the other quintiles. Moreover, a gender stratified analysis was tested. All analyses were performed using SPSS 15.0 (SPSS Inc., Chicago, IL).

4. Results

A total of 2688 adolescents aged 13.3 ($\pm$0.48) years with 1378 (51.3%) being male were analyzed (Table S1). Approximately 40% of participants were recruited from Taipei City, another 40% from New Taipei City, and the rest 20% from Yilan County. Most lived with a household income between 30,001 and 59,999 New Taiwan Dollars. PCA reached a final solution of 8-factor scale with the eigenvalues assigned to each factor ranging from 1.72 to 4.65 (Table S2). These factors accounted for 58.6% of the total variance and they could be accordingly grouped into four external asset factors (family support, school support, parental monitoring, and family boundary) and four internal (self-esteem, positive values, school bonding, and social relationship). Each factor score was calculated using regression methods, and a summed score from each factor represented the overall developmental asset profile (Cronbach $\alpha = 0.87$).

Family support ($r = -0.29 \sim -0.234$, $p < 0.01$) and social relationship ($r = -0.311 \sim -0.271$, $p < 0.01$) were most implicated in the cross—sectional correlation with less depressive symptomatology and less self-rated unhappiness (Fig. 1). Likewise, self-rated unhealthiness was most correlated with lower self-esteem ($r = -0.239$, $p < 0.01$), while deviant behaviors were most correlated with less parental monitoring ($r = -0.165$, $p < 0.01$). In addition, a lower score on the overall scale was significantly correlated with depression symptomatology ($r = -0.327$, $p < 0.01$), self-rated unhealthiness ($r = -0.288$, $p < 0.01$), self-rated unhappiness ($r = -0.369$, $p < 0.01$), and deviant behaviors ($r = -0.176$, $p < 0.01$). However, body weight status was not correlated with these developmental assets.

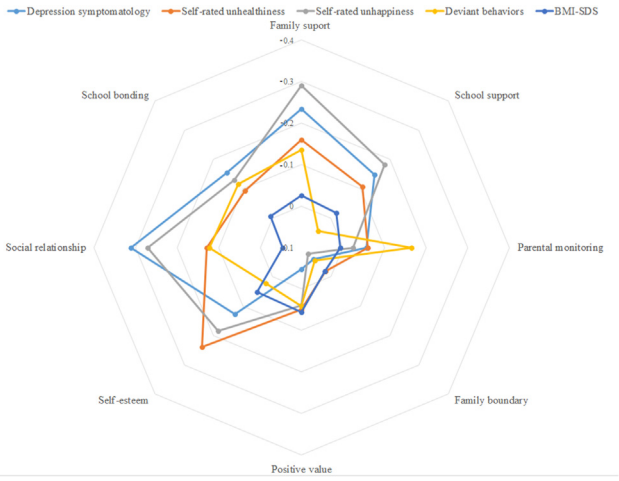

Figure 1 Correlation coefficients between different dimensions of the youth developmental asset scale and the cross-sectional data of self-rated unhappiness and unhealthiness, depressive symptomatology, problematic behaviors, and weight status. BMI-SDS represents standardized BMI scores.

In the longitudinal association analysis applying GEE models (Table 1), it was found that those in the highest quintile of scores on the developmental asset scale, which indicated possessing the fewest developmental assets, were more likely to have more depressive symptomatology ($\beta = 4.18$ [95% confidence interval 3.35, 5.01]), lower self-rated health ($\beta = 0.33$ [0.26, 0.40]) and less happiness ($\beta = 0.47$ [0.41, 0.54]), and more deviant behaviors ($\beta = 0.63$ [0.44, 0.81]), as compared to those in the lowest quintile of scores. The impacts remained significant even after Bonferroni's correction ($p < 0.01 = 0.05/5$), if the effects of the multiple correlated testing were considered. A dose response was clearly noted in the association coefficients with these psychosocial outcomes across the gradient of developmental assets. Stratified by gender, the significance remained consistent with these findings. Likewise, our analysis did not observe a longitudinal effect of adolescent developmental assets on the BMI trajectory.

5. Discussion

Aligned with the PYD theory, this present study demonstrated a longitudinal impact of positive developmental assets on adolescent psychological and behavioral outcomes in young adulthood using the national representative data. Prior research contextualized the important sources that adolescents could access to reduce multiple internalizing and externalizing behaviors.[23] Several studies also supported a significant association between developmental assets and success in social integration, academic achievement, self-competence and mental wellbeing.[7,8,10,23,24] Further, synthesized evidence shows that PYD programs that address a comprehensive range of promotional and protective factors are effective in ameliorating multiple developmental outcomes.[25,26] Putting the PYD scheme in a global perspective, research showed that participants, regardless of their cultural backgrounds, demonstrated sizeable gains in young

Table 1 Longitudinal effects of youth developmental assets on self-rated happiness and health status, depressive symptomatology, deviant behaviors, and weight status in generalized estimating equation analysis.

	Level of developmental assets			
	2nd quintile (high)	3rd quintile (average)	4th quintile (low)	5th quintile (lowest)
	β (95% CI)	β (95% CI)	β (95% CI)	β (95% CI)
Overall sample				
Depression symptomatology	0.82 (0.18, 1.45)	2.31 (1.65, 2.97)*	2.77 (2.06, 3.47)*	4.18 (3.35, 5.01)*
Self-rated unhealthiness	0.10 (0.03, 0.18)*	0.17 (0.10, 0.24)*	0.23 (0.16, 0.30)*	0.33 (0.26, 0.40)*
Self-rated unhappiness	0.14 (0.08, 0.20)*	0.24 (0.18, 0.30)*	0.30 (0.24, 0.36)*	0.47 (0.41, 0.54)*
Deviant behaviors	0.01 (−0.11, 0.13)	0.31 (0.17, 0.46)*	0.20 (0.07, 0.33)*	0.63 (0.44, 0.81)*
BMI-SDS	−0.15 (−0.31, 0.01)	−0.09 (−0.25, 0.07)	−0.06 (−0.23, 0.10)	−0.08 (−0.25, 0.10)
Males				
Depression symptomatology	0.79 (−0.04, 1.61)	2.33 (1.44, 3.21)*	3.11 (2.16, 4.07)*	3.93 (2.71, 5.16)*
Self-rated unhealthiness	0.11 (0.02, 0.21)	0.14 (0.05, 0.23)*	0.20 (0.11, 0.29)*	0.29 (0.19, 0.39)*
Self-rated unhappiness	0.15 (0.06, 0.24)*	0.23 (0.14, 0.32)*	3.10 (0.22, 0.40)*	0.47 (0.38, 0.57)*
Deviant behaviors	−0.03 (−0.23, 0.17)	0.47 (0.21, 0.73)*	0.20 (−0.01, 0.41)	0.93 (0.60, 1.25)*
BMI-SDS	−0.13 (−0.36, 0.11)	−0.15 (−0.38, 0.07)	−0.09 (−0.33, 0.15)	−0.14 (−0.40, 0.12)
Females				
Depression symptomatology	0.82 (−0.14, 1.79)	2.29 (1.31, 3.27)*	2.33 (129, 2.37)	4.45 (3.31, 5.60)*
Self-rated unhealthiness	0.09 (−0.02, 0.18)	0.20 (0.09, 0.30)*	0.26 (0.16, 0.35)*	0.37 (0.27, 0.47)*
Self-rated unhappiness	0.13 (0.03, 0.22)*	0.25 (0.17, 0.34)*	0.30 (0.21, 0.39)*	0.48 (0.39, 0.57)*
Deviant behaviors	0.05 (−0.08, 0.18)	0.17 (0.03, 0.30)	0.18 (0.03, 0.33)	0.36 (0.18, 0.54)*
BMI-SDS	−0.18 (−0.40, 0.04)	0.00 (−0.22, 0.22)	−0.03 (−0.25, 0.19)	0.00 (−0.23, 0.23)

CI denotes confidence interval; BMI-SDS, standardized scores of body mass index among the same-age-and-gender group.
The reference group is the 1st quintile, which represents those with the highest level of youth developmental assets.
*$p < 0.01$.

people's experience of assets.[6] Extending the evaluation of effects in a longer term, the results observed increased odds of the association between developmental assets and subsequent depression symptoms, deviant behaviors, and perceived happiness and healthiness across the gradient of assets in the present cohort. The amount of positive resources that youth could have access to in adolescence significantly predicts their psychological and behavioral wellbeing in young adulthood. Promoting adolescent health with multiple contextual involvements, including family, school, and peer integration, may support positive developmental outcomes.

Dissecting the subdomains of developmental assets, it was found that family support, school support, self-esteem, social relationship and school bonding were correlated with psychological and behavioral outcomes in the cross-sectional analysis. Supportive family and social contexts help adolescents build self-esteem and peer belonging that will in turn affect the self-perception of life and well-being.[27] Parental monitoring, but not all family boundaries, was associated with decreasing deviant behaviors. Knowing about adolescents' friends and whereabouts has been shown to reduce untoward affiliation with deviant peers and hence decrease problem behaviors.[28] Setting family rules (and providing guidelines) is practically an essential parenting practice, but without explanation and discussion of the rules it may have negative effects. Family boundaries include the relationships and a set of family rules implemented within a household. Setting strict rules may heighten the possibility that adolescents interpret family boundaries as negative, intrusive, and controlling behaviors rather than an expression of care and support from their parents.[18] A tense parent−child relationship, incited by the misperception of family rules and boundaries may lead to adverse impacts on health behaviors and outcomes.[28] Another unexpected finding was the insignificant association between positive values and developmental outcomes. A recent meta-analysis of developmental asset build-up programs found that social-emotional skill development was the strongest predictor of wellbeing at follow-up.[29] In our subscale for positive values, the items were more relevant to moral virtues. These characteristics are usually indicated in association with youth education attainment.[30] There is some supportive evidence that virtues may play a positive role in moderating the psychological stress in college students.[31] Our study did not replicate this finding in a longitudinal relationship, which may require further investigation for verification. The other direction of research may refine the positive values, such as emotional coping attitudes, in the present social context.

The present study did not find an association between weight status and developmental assets. This is inconsistent with findings in previous studies that showed a crucial impact of PYD on decreasing fast food consumption and increasing physical activity.[7,11] Another cross-sectional study found that positive resources from the family and community contributed to healthy lifestyles.[23] However, the relationship with BMI data was not specifically analyzed in these previous studies. As it is well-known that the etiology of obesity and its related health is complex and involves interplay between health and the psychosocial/physical environment, the lack of independent association

does not preclude the potential for the association to be negatively confounded by health-related factors and the possibility for developmental assets to be effect modifiers. Although this study did not capture eating behaviors and physical activity, it seemed that the potential positive impacts of developmental assets on lifestyle factors were not contributory towards weight health in our studied cohort. These results may suggest a different causal mechanism on the psychical health outcome. Nonetheless, the results found that those with more positive developmental assets reported a higher perceived healthiness. Accumulating evidence has shown a consistent association between self-rated health and morbidity and mortality.[32] The evaluation process that individuals use to assess their overall health appears to be more inclusive than current physical status, as it encompasses assessments of health behaviors, psychosocial well-being, and projective trajectories in health over time.[33] While there may exist some discrepant interpretations of perceived and true health status, it remains an interesting research question how youth developmental assets can potentially affect the health trajectory in an even longer term beyond young adulthood.

There are some limitations in the present study. Firstly, the analysis relied on the subjects' self-reports. Some sensitive issues, such as deviant behaviors or BMI, may be under-reported because of social desirability.[34] This report bias may be improved if reports from other sources, like school teachers or parents, are available. Obtaining some more collateral reports may also ameliorate same-source bias, given that these self-report psychosocial measurements are likely to be highly correlated. Secondly, the participants were recruited exclusively in a school setting. School dropouts and absentees, who may be lacking more developmental assets, were largely missed in the analysis. This may affect our estimates of the effects of PYD, although the out-of-school population is small and constitutes only 0.5% of the adolescent population in Taiwan.[35]

6. Conclusions

This study provides some supportive evidence about the longitudinal impact of positive developmental assets on youth psychosocial outcomes from adolescence to young adulthood. Having greater developmental assets significantly contributes to less depression symptomatology, fewer deviant behaviors, and perceiving oneself happier and healthier. This finding highlights the important course of this stage of life, where positive development during adolescence may have lifelong implications. Herein, the implications may include identifying strength and weakness aligned with youth developmental assets and reinforcing the positive development during adolescence because their impacts on self-competence and psychosocial wellbeing are immediate and evident into young adulthood. From the clinical perspective, the positive youth development approach calls for a thorough assessment of internal and external assets when consulting adolescents for their complex psychosocial health issues, and in the meanwhile it aims to streamline health promotion interventions according to their developmental asset base to engage and empower youth to live healthily. However, the impact of developmental assets on physical health such as weight status was not obvious in our analysis. Further investigation is needed to elaborate whether additional interventions are required in young adulthood to maintain positive health promotion.

Ethical approval

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

Funding

This study was supported by the research grant from the National Cheng Kung University Hospital (NCKUH-10702001) and the Ministry of Science and Technology, Taiwan (MOST-106-2629-B-006-001).

Contributions

Tsai MC and Lin YC conceived the study. Tsai MC and Yu YF conduct and Strong C and Lin CY supervised the process of statistical analysis. Tsai MC and Ng J drafted and Hsieh YP critically reviewed the manuscript. All the authors have read and approved the final version of manuscript.

Availability of data and materials

The TYP dataset is archived in the Survey Research Data Archive, managed by the Institute of Sociology, Academia Sinica, Taiwan. It requires registration, although it is free and open to the public, when accessing to the dataset. All the waves could be found at the following link: https://srda.sinica.edu.tw/browsingbydatatype_result.php?category=surveymethod&type=2&csid=1.

Declaration of competing interest

The authors have no conflict of interest to declare.

Acknowledgments

The Taiwan Youth Project was sponsored by the Academia Sinica (AS-93-TP-C01) and directed by Dr. Chin-Chun Yi. The Center for Survey Research of the Academia Sinica is responsible for the data distribution. The authors thank Dr. Yi and everyone else at the Academia Sinica and the Taiwan Youth Project for providing the data and all the other administrative assistance they gave.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pedneo.2021.05.006.