

Research Article

Associations Between Nutritional Status and Mental Health Outcomes among Adolescents in Sarawak, Malaysia: Double Burden in Adolescents

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ABSTRACT

This study aimed to determine the prevalence of nutritional status and mental health problems among adolescents in the Samarahan District, Sarawak, and to explore their relationship. A cross-sectional study was conducted on 450 adolescents aged 10–19 years old. Nutritional status was assessed using Body Mass Index (BMI)-for-age and height-for-age z-scores, and mental health was evaluated using the Strengths and Difficulties Questionnaire (SDQ). The SDQ was validated and translated into the Malay language. The internal consistency was 0.71, and the item-total correlation exceeded 0.3. Spearman's correlation was used to analyse relationships between variables. The study revealed that 25.1% of the adolescents were overweight or obese, while 9.4% were underweight. Stunting affected 12% of the participants. The mental health assessment revealed that 26.7% of adolescents fell within the abnormal range. The SDQ score was categorised into normal (0–15), borderline (16–19), and abnormal (20–40). Weak but significant correlations were found between BMI-for-age z-scores and conduct problems status ($r=-0.105$, $p<0.05$) and between gender and emotional conduct problems ($r=0.158$, $p<0.001$). This study highlights the coexistence of malnutrition and mental health issues among adolescents in Sarawak. Integrated interventions addressing both nutritional and mental health needs are recommended, with a particular focus on gender-specific approaches and peer relationship support.

INTRODUCTION

Adolescents represent a critical demographic in public health, as they are particularly vulnerable to nutritional deficiencies and mental health disorders. Globally, the prevalence of malnutrition among adolescents is alarming, with significant disparities observed in different regions, including Malaysia. For instance, studies indicate that a substantial proportion of Malaysian adolescents experience nutritional issues, such as undernutrition and obesity, which are closely linked to socioeconomic factors and dietary habits (Krishnan *et al.* 2021; Wong *et al.* 2024; (Lai *et al.* 2024). Concurrently, mental health problems, including anxiety and depression, are increasingly recognised as prevalent among adolescents in Malaysia, with estimates suggesting that one in five adolescents

suffers from depression (Singh *et al.* 2022). The interplay between nutritional status and mental health is particularly concerning; research has shown that poor nutritional status can exacerbate mental health issues, leading to a cycle of disadvantage that affects educational outcomes and overall well-being (Ahmad *et al.* 2015; Nauli *et al.* 2021; Pauzi & Sahide 2023).

Adolescent malnutrition is a pressing public health issue, particularly in Malaysia, where it manifests as both undernutrition and overnutrition, leading to a double burden of malnutrition. This duality is concerning because it not only affects physical health but also has profound implications for mental health. Adolescents facing malnutrition are at increased risk of cognitive impairments, emotional disturbances, and behavioural issues, which can lead to long-term consequences such as depression

and anxiety (Nauli *et al.* 2021; Estechea Querol *et al.* 2021). The significance of this study lies in its potential to illuminate the intricate relationship between nutritional status and mental health outcomes among adolescents, thereby informing public health interventions and policies aimed at improving both nutritional literacy and mental health support systems (Nearchou *et al.* 2020; (Kirolos *et al.* 2022). With the COVID-19 pandemic exacerbating existing vulnerabilities, understanding these associations is crucial for developing effective strategies to mitigate the adverse effects of malnutrition on mental health, ultimately fostering healthier future generations (Bera *et al.* 2022; Nearchou *et al.* 2020). This study aimed to determine the prevalence of nutritional and mental health statuses of adolescents and the relationship between nutritional status and mental health outcomes, hypothesising that poor nutritional status may correlate with increased mental health issues.

METHODS

Design, location, and time

This study was conducted in the Samarahan District, a rural area in Sarawak, Malaysia, covering 407.08 square kilometres and with a population of 134,600, including 19,500 adolescents as of 2023 (Department of Statistics Malaysia 2024). Samarahan district which adjacent to Kuching district had a good mixture of urban and rural communities reflecting a heterogeneity of population in Sarawak. More importantly, the national data through the national health morbidity survey demonstrated that Sarawak had among the highest prevalence of overweight, obesity and mental health problems among adolescents in Malaysia, but the district-level data remain limited (National Institutes of Health (NIH) 2022). A cross-sectional study design was employed to simultaneously measure and analyse the nutritional status and mental health problems of adolescents. This design was selected because it allowed for the identification of the prevalence of these issues among adolescents in a cost-effective manner within a limited timeframe of approximately one year from October 2023 to September 2024. The study population consisted of adolescents aged 10–19 years, regardless of gender or ethnicity, while those without parental consent or with pre-existing mental health issues were excluded. The findings of this research will

provide essential insights for future program and policy planning and may serve as a baseline for repeated studies in this population over time.

This study adhered to strict ethical standards and obtained approval from the University Malaysia Sarawak Ethics Committee (Ref No. FME/24/83, 22 February 2024). Permission was obtained from the Samarahan District Office, and community leaders were briefed on the study's purpose.

Sampling

The study employed a multistage sampling method whereby a sample was chosen of 25 villages out of 66 villages in the Samarahan District (NHI 2020). Adolescents were randomly recruited from 18 selected villages. The first choice was initiated at the home of the Village Headman and followed in clockwise western, northern, eastern, and southern parts of the village until the intended sample size was achieved. This five-phase method was explained by the fact that an extensive census of all teenagers in the district was practically unsustainable, and that there was no standardised list of teenagers in Samarahan. As a result, the step-by-step movement through villages helped to incorporate the participants in different regions in a randomised fashion.

Based on the Cochran's formula, the Z score of 1.96 with a 95% Confidence Interval, 0.05% margin of error, a prevalence of 42.9% and a 15% non-response rate, 434 respondents were needed in this study, and the sample was rounded to 450.

Data collection

A combination of approaches was utilised in an integrated manner, including a structured questionnaire with three parts: sociodemographic and personal features, the Strengths and Difficulties Questionnaire (SDQ), and anthropometric measures. The questionnaire provoked responses on the adolescent background, behaviour, and mental health. Body weight and height measurements were used as anthropometric data. The data collection process began in February 2024 after obtaining permission from the Samarahan District Office and after a meeting with village heads. Face-to-face interviews were done using Malay-translated questionnaires with the help of trained staff. The anthropometric measurements were conducted following standardised protocols to ensure

accuracy and reliability. Height was measured with a stadiometer, and weight was recorded on calibrated scales.

A pilot test was conducted on 40 adolescents to test the measurement tools and the general study procedures. The main purpose of this open-ended research was to assess the understandability of the questionnaire, to estimate the response time trends and to determine the overall feasibility of the proposed study. The instrument's internal consistency was satisfactory, with a Cronbach's alpha of 0.80 in the pilot data. These pre-test outcomes provided a basis of both instrumental and procedural improvements before the start of the actual study.

Mental health status. Adolescents were divided into internalising and externalising difficulties as measured by the Strengths and Difficulties Questionnaire (SDQ), which was translated into English. Data was collected using structured, face-to-face interviews through trained staff using a Malay version of the questionnaire. The SDQ employs a 3-point Likert scale ('Not true', 'Somewhat true', 'Certainly true') across five domains: emotional problems, conduct problems, hyperactivity, peer problems, and prosocial behaviour (Hassan *et al.* 2019). The total difficulty score, calculated by summing the scores from the emotional, conduct, hyperactivity, and peer problem scales, determines the presence of mental health problems. Scores were categorised as normal (0–15), borderline (16–19), or abnormal (20–40).

Nutritional status. In adolescents, nutritional status is assessed using the Body Mass Index (BMI), which is calculated from the measured weight and height. The BMI-for-age z-score was calculated using the WHO AnthroPlus software, which considers the participant's date of measurement, date of birth, weight, height, and gender. According to the WHO, age- and sex-specific BMI z-score cut-offs for 5–19 years, participants were classified as "Overweight" (BMI z-score $> +1$ SD) or "Obese" (BMI z-score $> +2$ SD). Thinness was classified when the BMI z-score was < -2 SD, and severe thinness was classified when the BMI z-score was < -3 SD (World Health Organization (WHO) 2023). Height-for-age z-scores were used to determine stunting. Height attained during adolescence is largely determined by nutritional, infectious and socioeconomic exposure during early childhood (Gonzalez-Fernandez *et al.* 2023; Prentice *et*

al. 2013). Thus, it depicts the cumulative effect of nutritional exposure in early childhood. The Height for age z-score was classified as normal (≥ -2 SD to $\leq +2$ SD), stunted (< -2 SD) and severely stunted (< -3 SD) according to WHO Reference 2007 (Onis *et al.* 2007).

Data analysis

Data entry was done using Microsoft Excel to ensure data accuracy and consistency. The dataset was then imported into SPSS version 29 for comprehensive statistical analysis. All nutritional data, namely BMI-for-age and height-for-age z-scores, were calculated using the WHO AnthroPlus software, which is designed explicitly for anthropometric measurements in children and adolescents. Descriptive statistics were calculated for all variables as frequency, percentage, mean, and standard deviation. Continuous variables were tested for normality using the Shapiro-Wilk test. Because several non-normally distributed and ordinal variables, particularly in the area of mental health, were included, inferential statistics were conducted using Spearman's rank correlation. This non-parametric measure was selected to investigate the association between nutritional status variables, indicated by BMI-for-age and height-for-age z-scores, and other demographic variables, including those related to mental health. The Spearman rank-order correlation coefficient was adopted as a measure of association because it does not require linearity or normality in the underlying distributions to model a monotonic relationship appropriately. Statistical significance was set a priori as a two-sided $p < 0.05$ for all analyses.

RESULTS AND DISCUSSION

The sociodemographic profiles of the 450 adolescents surveyed in Sarawak closely mirror the trends observed across Malaysia, particularly in East Malaysian states. The average age of the respondents was 15.27 years (SD=2.8 years). The majority of participants identified as Malay (69.1%) and Islam (72.9%), which is indicative of the predominant ethnic and religious demographics in this region. Bumiputera Sarawak (27.1%) and Chinese (3.8%) were also represented (Table 1). The participants' income ranged from MYR100 to MYR30,000 (approximately USD 23 to USD7,100), with a mean of MYR3,617.92 (approximately USD856.31; SD=4,036.16)

Table 1. Characteristics of adolescents

Characteristics	n (%) (n=450)
Age in year, (mean±SD)	15.27±2.80
10–14	164 (36.4)
15–19	286 (63.6)
Gender	
Male	253 (56.2)
Female	197 (43.8)
Ethnicity	
Malay	311 (69.1)
Bumiputera Sarawak	122 (27.1)
Chinese	17 (3.8)
Religion	
Islam	328 (72.9)
Christian	114 (25.3)
Buddha	8 (1.8)
Income group	
<RM4,849 (USD1,194)	340 (75.6)
RM4,850–10,959 (USD1,195–USD2,699)	87 (19.3)
>RM10,960* (USD2,699)	23 (5.1)
Father's Education	
No school	11 (2.4)
Primary School	69 (15.3)
Lower Secondary	135 (30.0)
Higher Secondary	145 (32.2)
Degree	90 (20.0)
Mother's Education	
No school	6 (1.3)
Primary School	63 (14.0)
Lower Secondary	138 (30.7)
Higher Secondary	141 (31.3)
Degree	102 (22.6)
Father's Occupation	
No job	39 (8.7)
Government sector	130 (28.9)
Private sector	96 (21.3)
Self-employed	128 (28.4)
Others (farming, industrial workers, homemakers etc.)	57 (12.7)
Mother's Occupation	
Government sector	115 (25.6)
Private sector	51 (11.3)
Self-employed	26 (5.8)
Homemakers	236 (52.4)
Others (farming, industrial workers, etc.)	22 (4.8)

RM: Ringgit Malaysia; SD: Standard Deviation; USD: U.S Dollar

and a median of MYR2,000 (approximately USD473.37). Economic challenges were also evident, with 75.6% of the population having a monthly income of less than RM4,849; this was expected, as seen among the urban poor population in Malaysia, whereby a large percentage of adolescents were found to reside in low-income homes, thereby being at risk of health inequalities (Kumar *et al.* 2018; Wong *et al.* 2024). Parental educational status was moderate, with approximately one-third having completed higher secondary education and more than 20 per cent holding degrees, similar to national patterns. These profiles are known to be positively associated with adolescent health and school engagement (Ishak *et al.* 2020; Nauli *et al.* 2021). Gender roles were evident, as fathers were mainly employed in government or self-employed sectors, while over half of mothers were homemakers, reflecting socio-cultural norms and findings that maternal presence at home provides supervision and support, whereas paternal employment confers economic security (Wong *et al.* 2024; Yee 2023). Together, these sociodemographic factors are protective and risk factors for adolescent well-being. The above observation highlights the critical role of ethnicity, income, education and family unit set-ups in determining the complex and more pronounced contexts of adolescent health and development in Malaysia.

The dietary examination of the 450 adolescents showed that there were varied body masses and developmental trends. Two-thirds (65.6%) of them had normalised (Z score within normal range) BMI-for-age Z-scores. Nonetheless, a considerable percentage of them had weight-related concerns, 14.0 3% were rated as overweight and 11.1 3% were obese. On the other hand, 5.8% were said to be skinny and 3.6% to be severely skinny. Height-age z-scores indicated that the majority of adolescents (88%) were of normal stature. However, stunted growth was observed among a sizeable group of the population, where 9.8% had been found to suffer mild to moderate stunting and 2.2% had severe stunting. These results indicate that there is a condition of both undernourishment and overnutrition among the adolescent population (Table 2). Such trend corresponds to the increasing rates of undernutrition and overnutrition, which is consistent with both recent Malaysian and global data on the same population, which point

Table 2. Nutritional status of the adolescents

Nutritional status	n=450 n (%)
BMI for age z-score, (mean±SD)	-0.0486±1.61
Obese	50 (11.1)
Overweight	63 (14.0)
Normal	295 (65.6)
Thin	26 (5.8)
Severe thinness	16 (3.6)
Height for age z-score, (mean±SD)	-0.9319±1.01
Normal	396 (88.0)
Stunting (mild to moderate)	44 (9.8)
Severe stunting	10 (2.2)

BMI: Body Mass Index; SD: Standard Deviation

to similar trends in youth populations in low-and-middle-income countries (NIH 2020; Krishnan *et al.* 2021; Kumar *et al.* 2018; Lee *et al.* 2022; Partap *et al.* 2019). As an example, studies in India and Malaysia have published statistics on overweight and obesity among adolescents of approximately 25–26%, as well as on underweight and stunting, which is normally associated with socioeconomic differences, rural living, and the quality of food (Krishnan *et al.* 2021; Kumar *et al.* 2018; Lee *et al.* 2022). It is a particularly concerning situation that all these nutritional problems co-exist, as there are risk factors to adolescent physical and cognitive growth, and it is possible to conclude that issues are more than simply additive and lead to increased susceptibility later in life (Nauli *et al.* 2021; Wang *et al.* 2019).

A thorough review of 450 adolescents undergoing mental health assessment using the Strengths and Difficulties Questionnaire revealed a range of difficulties across several domains. The level of emotional issues was not that high, and 80.2% of the respondents rated in the norm range. The same trends were found in conduct and hyperactivity, as 62.0% of the teenagers were assessed to be normal in the two aspects. Peers related issues were, on the other hand, more common and even out of the normal range; 24.2% was only normal, and 33.3% were abnormal. Pro-social behaviour was overall good where 77.1% adolescents showed normal levels. The average score of the mental-health status measure was 16.18, and the standard deviation was 5.5, which means that, on average, the participants were a little to slightly distressed psychologically. However, there was a group of people with

higher scores, which reflects moderate or even worse distress. Upon categorisation, the general mental-health status indicated that 44.9% of the participants had the normal range, 28.4% had the borderline, and 26.7% had the abnormal. Such findings mean that a significant percentage of adolescents are in good mental health, but a great percentage of adolescents face challenges, particularly in peer relationships and mental health in general, meaning that interventions and support can be facilitated (Table 3).

In the aspect of mental health, 26.7% of the teenagers in our research displayed deviations, especially in terms of peer relationships, and 33.3% replied that they had problems in this regard. The given results are in line with the statistics provided by the World Health Organization, which states that more than half of all mental disorders appear before 14 years of age (Erskine *et al.* 2016). It has been shown

Table 3. Mental health status of adolescents

Mental health status	n=450 n (%)
Emotional problems status	
Normal	361 (80.2)
Borderline	40 (8.9)
Abnormal	49 (10.9)
Conduct problems status	
Normal	279 (62.0)
Borderline	78 (17.3)
Abnormal	93 (20.7)
Hyperactivity problems status	
Normal	279 (62.0)
Borderline	86 (19.1)
Abnormal	85 (18.9)
Peer problems status	
Normal	109 (24.2)
Borderline	191 (42.4)
Abnormal	150 (33.3)
Pro-social behaviour status	
Normal	347 (77.1)
Borderline	55 (12.2)
Abnormal	48 (10.7)
Overall mental health status	
Normal	202 (44.9)
Borderline	128 (28.4)
Abnormal	120 (26.7)

in the past by, among others, Nauli *et al.* (2021), that adolescent mental-health problems correlate with academic problems, and that adolescents are more susceptible to substance misuse. In addition, Wong *et al.* (2024) have contributed to the idea that socioeconomic determinants can exacerbate health disparities, which, in turn, influence nutritional status and mental health. There are also differences in our study, in comparison to the high prevalence of emotional problems in the neighbouring countries, including Indonesia, which implies varying cultural levels of manifesting psychological distress. The high rates of peer-related issues underscore the importance of social relationships in adolescent mental health, underscoring the need to develop positive relationships with peers (Long *et al.* 2020).

The analysis of the relationships between nutritional status and its associated factors among adolescents in Sarawak has revealed complex interconnections between physical health and psychosocial outcomes (Table 4).

The female participants in our research showed a small negative correlation between the z-scores on height-age with psychosocial outcomes, and at the same time, they reported a higher degree of emotional disturbance and pro-social behaviour; therefore, it is possible that girls in our study found it easier to encounter emotional problems and are more likely to be involved with pro-social interactions. Such results are consistent with the existing literature recording gender-specific mental-health patterns in the context of Malaysian adolescents (Nauli *et al.* 2021; Sahril *et al.* 2023).

In the spectrum of analysed areas within mental health, there was also a moderate pattern of cross-correlations between emotional dysregulation, conduct problems, hyperactivity and peer relations difficulties. Interestingly, hyperactivity showed a beneficial interaction with pro-social behaviour, highlighting the multifaceted interplay of the attentional dysregulation and pro-social adaptation in adolescence (Chávez *et al.* 2025; Jafar *et al.* 2020; Van Vuuren *et al.* 2019).

The BMI-identity z-scores were poorly negatively related to conduct problem scores, which may provide some limited evidence in support of the hypothesis that increased body mass index might be negatively related to decreased conduct pathology. However, the evidence on the association between mental-health and obesity in adolescents is imprecise compared to that in the adult groups (Mühlig *et al.* 2016; O’Neil *et al.* 2014). Altogether, these findings shed some light on the interaction among nutritional status, gender, and psychological characteristics. The correlations are often indirect and buffered by larger social settings, physical health, and personal behavioural patterns (Jafar *et al.* 2020; Marinković *et al.* 2024). Even empirical studies demonstrate that the best eating habits and a positive peer interaction are protective measures with regard to emotional and behavioural disturbance. As a result, the urgent need to consider multi-pronged interventions that encompass nutrition, mental health, and social capital as the primary measures of ensuring a holistic development of adolescents is a distinct,

Table 4. Correlation matrix of age, gender, nutritional status and mental health status of adolescents

Parameters	1	2	3	4	5	6	7	8	9
Age	--								
Gender (0=male, 1=Female)	-0.018	--							
Height for Age z-score	-0.016	-0.136*	--						
BMI for Age z-score ^a	-0.043	-0.007	-0.004	--					
Emotional problems	0.082	0.158***	-0.089	-0.037	--				
Conduct problems	-0.012	0.004	-0.004	-0.105*	0.354***	--			
Hyperactivity problems	0.033	-0.052	0.010	-0.012	0.396***	0.320***	--		
Peer problems	0.057	-0.046	-0.022	-0.012	0.162***	0.274***	0.307***	--	
Pro-social behaviour	-0.040	0.142**	-0.020	-0.044	0.039	-0.038	0.138**	0.211***	--
Total mental status	0.057	0.041	-0.048	-0.057	-	-	-	-	-

^aBMI: Body Mass Index (kg/m²); *p<0.05; **p<0.01; ***p<0.001; p-value reached from Spearman Rho; The redundant correlation coefficient is not shown in the table

pressing issue (Nauli *et al.* 2021; O'Neil *et al.* 2014; Wang *et al.* 2019).

There are several weaknesses in this study that should be taken into account when assessing the results. First, the cross-sectional design utilised initially does not allow drawing causal correlations between the mental health outcomes and the nutritional status. More so, the use of self-report data means that there is the likelihood of reporting bias that would interfere with the accuracy of the mental health assessments. Regardless of these possible problems, the use of trained interviewers probably contributed to the improvement of the quality of the data gathered and the reliability of the responses. Lastly, the focus of the study does not make the results of the study broadly applicable to other regions of Sarawak or Malaysia in general because the study has only focused on the Samarahan District. The heterogeneous urban and rural environment demographic structures, on the other hand, offer relevant views applicable to the population with similar sociodemographic traits. More so, the constraints of the study were in the fact based on the consideration of only some number of sociodemographic variables which may fail to take into account various confounding factors within the relationship between nutritional status and mental well-being. Although BMI is a commonly used measure of nutritional condition, it does not meet the changes in body composition or fat distribution. Lastly, the lack of nutritional and physical activity measurements of dietary and physical activity in the study design does not allow a deeper analysis of the factors affecting the state of nutrition and mental condition. In turn, the studies that may alleviate these misgivings in the future may bring a better-adjusted understanding of the complex connection between nutrition and adolescent mental health.

CONCLUSION

The purpose of the current study was to explore the nutritional condition and psychological health of the adolescents living in the Samarahan District in Sarawak, Malaysia. Although most participants have body-mass-index-ages and height-ages-z-scores within the normal range, a significant proportion of teenagers showed both underweight and overweight, indicating a dual burden of malnutrition in the given population. Although a significant number

of adolescents showed mainly favourable indices of mental health, those who reported problems with peer interactions were a minority. Statistical tests showed weak yet statistically significant correlations between BMI-for-age Z-scores and conduct problems. Besides, sex-specific correlations were found between z-scores of BMI-for-age and emotional problems, as well as prosocial behaviour, indicating a relationship among nutritional condition, mental-health indices, and sociodemographic factors. These results underline the need to develop inclusive public health initiatives that address both nutritional and mental health needs among teenagers. Another focus they draw is the need to employ gender-sensitive strategies and to empower peer-support systems. These interrelationships have been observed; consequently, future policy and programme approaches involving the community in public health programmes must clearly seek to include these relationships to achieve greater success in promoting adolescents' holistic well-being.

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DECLARATION OF CONFLICT OF INTEREST

The authors state that they have no conflict of interest that could have influenced the work reported in this study. Both authors equally contributed to the conception, design, data collection, analysis, and preparation of the manuscript. All the authors reviewed and approved the final manuscript.

The data supporting this study's findings are available from the corresponding author upon reasonable request and are subject to ethical approval.

DECLARATION OF GENERATIVE AI IN SCIENTIFIC WRITING

No generative AI were used for content creation, data analysis or scientific interpretation.

Proofreading services were used solely for polishing language and grammar.

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