





# An investigation of adolescents' emotional and behavioral manifestations and the factors influencing cases from Bulgan Province, Mongolia

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**Objective:** This study aimed to investigate factors potentially influencing the mental health of adolescents. **Methods:** A population-based birth cohort study was conducted in Bulgan Province from 2016 to 2022. Emotional and behavioral manifestations in children were assessed using the Strengths and Difficulties Questionnaire – Mongolia (SDQ-Mongolia). Risk factors affecting emotional and behavioral outcomes among children aged 6, 9, and 12 years were analyzed using multinomial logistic regression models. **Results:** The study included 1,077 parent–child pairs in 2016, 890 pairs in 2019, and 781 pairs in 2022. According to maternal reports, 81.89% of children in 2016, 71.8% in 2019, and 81.05% in 2022 exhibited abnormal emotional and behavioral manifestations. Among 12-year-old children, abnormal emotional and behavioral manifestations were significantly associated with lack of parental attention (adjusted Relative Risk Ratio [aRRR] 2.0, 95% Confidence Interval [CI] 1.09–3.68), reduced sleep duration (aRRR 2.22, 95% CI 1.21–4.08), and increased mobile phone use (aRRR 3.36, 95% CI 1.02–11.0). **Conclusions:** Lack of parental attention, reduced sleep duration, and higher mobile phone usage are significant factors influencing abnormal emotional and behavioral manifestations among adolescents.

**Keywords:** Behavior, Cell Phone Use, Emotion, Peer Group, Sleep Deprivation

## Introduction

In developed countries, developmental surveillance of adolescent mental health issues and the prevalence of cognitive and physical diseases is monitored through large-scale follow-up studies, and researchers have noted that this approach is aimed at obtaining a wide range of information and knowledge. Research has shown that childhood mental health problems cause a significant burden of disease worldwide, accounting for 15–30% of life years with disability.<sup>1</sup> Mental health problems in children under the age of 18, including intellectual and developmental disabilities, occur in 10–20% of the population worldwide.<sup>2</sup> Children with mental health problems face long-term difficulties in many areas, including social, emotional,



and educational outcomes. Therefore, identifying modifiable factors that contribute to children's mental health problems is essential for the healthy growth and development of adolescents. However, this issue is often neglected, and mental health services are inadequately provided in low- and middle-income countries.<sup>3</sup> In recent years, the WHO has recommended that countries in the Asia-Pacific region develop policies and increase funding to improve mental health services.<sup>4</sup>

Adolescent mental health has increasingly been recognized as a critical global public health priority. In high-income countries, developmental monitoring of psychological well-being, cognitive functioning, and the prevalence of mental disorders is frequently undertaken through large-scale longitudinal studies. These studies provide comprehensive and multifaceted evidence that informs policy formulation and program development. According to the World Health Organization (WHO), approximately one in ten children experiences developmental mental health difficulties, and nearly 20% develop mental disorders during adulthood.<sup>5</sup> Stressful life events such as domestic violence, poverty, and exposure to natural disasters are among the key determinants that adversely affect children's mental health. Notably, the WHO's 2022 report documented a 30% increase in mental health problems among children during the COVID-19 pandemic.<sup>5</sup> WHO research and policies play an important role in developing Mongolian child health policies, and adapting and implementing them to local conditions is key to improving child health in the region.<sup>5</sup>

The onset of psychological disorders during adolescence carries lifelong implications, as this developmental stage represents a critical period of transition characterized by rapid physical, psychological, and social changes. Mental health difficulties at this stage can substantially influence educational achievement, interpersonal relationships, and long-term emotional well-being. Given that approximately 90% of the world's children reside in low- and middle-income countries, the promotion of adolescent mental health constitutes a pressing global concern.<sup>6</sup> Addressing modifiable risk factors during this formative period is essential for ensuring healthy growth and development.

If a child experiences mental health problems, they may experience long-term difficulties in social, emotional, and educational settings. Adolescence is a vulnerable and transitional period in a person's life, characterized by many changes in physical, psychological, and social relationships. During this

period, a child's psychological state and mental health have a significant impact on their future quality of life. Therefore, paying attention to the mental health of adolescents is an important public health issue, and identifying modifiable factors that can be specifically addressed in the mental health of adolescents is important for the healthy growth and development of children.<sup>7</sup>

Evidence indicates that in low-income Asian countries, approximately 11.8% of children may experience mental health problems.<sup>8</sup> In Mongolia, access to comprehensive mental health services for adolescents remains limited. Findings from a school-based baseline survey revealed that 43% of 2,250 students exhibited symptoms indicative of mental health difficulties.<sup>9</sup> Despite the urgent need for robust child and adolescent mental health policies, significant challenges such as inequitable access to healthcare services and a shortage of specialized professionals continue to hinder progress.<sup>10</sup> Consequently, epidemiological studies aimed at identifying risk factors, enhancing early detection, and strengthening preventive interventions are of particular significance in this context. It is important to increase early detection, prevention, and intervention for mental health risks, and there is a lack of professional child mental health services and early detection systems.<sup>10</sup>

Research on adolescent mental health in rural Mongolia remains limited, despite the necessity of understanding developmental processes within specific sociocultural contexts.<sup>7</sup> To address this gap, a longitudinal follow-up study was initiated utilizing the Maternal and Child Health Handbook implemented for the first time in Mongolia. This cohort study followed children born in Bulgan Province in 2010 across four waves of data collection at three-year intervals, reaching 12 years of age in 2022. The primary objective of this study is to identify the determinants of mental health problems among rural adolescents and to provide empirical evidence regarding which levels of the health system should be prioritized to improve adolescent well-being. Data on the mental health, cognition, and health problems of 12-year-old adolescents participating in a follow-up study in rural areas will be an important indicator of future trends in adolescent mental health.<sup>7</sup>

Twelve years of age represents a pivotal stage of rapid physical, cognitive, and emotional development.<sup>7</sup> Data obtained from this follow-up study provide critical insights into the current mental health status of adolescents in rural Mongolia and serve as an evidence base for the formulation of effective

policies and interventions aimed at fostering healthy adolescent development. This study aimed to assess the current status of emotional and behavioral manifestations among adolescents in Bulgan Province, Mongolia, and to identify the associated risk factors influencing these outcomes.

## Material and Methods

### Study Design and Setting

This study was conducted in Bulgan Province, Mongolia, as part of a population-based longitudinal birth cohort. To strengthen public health services, particularly maternal monitoring, and to support the nationwide implementation of the Maternal and Child Health Record, a pilot program was initiated in Bulgan aimag in 2010. In collaboration with the National Center for Child Health and Development of Japan, a baseline study was conducted in 2013 to assess maternal health education and factors influencing child health and development in Bulgan aimag.

Bulgan aimag has an estimated population of 62,248 with approximately 1,000 live births annually, and its population structure, consisting of 45 percent nomadic and 55 percent sedentary residents, closely reflects Mongolia's national demographic dynamics, which made it an appropriate setting for this pilot study. In 2010, all mothers who gave birth in the province were enrolled in the cohort and subsequently followed up when their children reached the ages of 6, 9, and 12 years. The number of mother-child pairs assessed during each follow-up was as follows: 1,077 in 2016, 890 in 2019, and 781 in 2022.

### Participants

The study population comprised mothers who gave birth in Bulgan Province in 2010 and their children. For the present analysis, data collected at the 6-, 9-, and 12-year follow-ups were included. Participation in the study was voluntary.

### Instruments

Children's emotional and behavioral manifestations were evaluated using the Strengths and Difficulties Questionnaire (SDQ) a validated 25-item instrument designed to screen for psychosocial adjustment in children and adolescents. The SDQ has been translated into more than 60 languages, utilized in 102 countries, and cited in over 4,000 peer-reviewed publications. We used the official Mongolian version of the SDQ. Mothers

completed the questionnaire by rating their child's behavior over the preceding six months. The instrument consists of five subscales, each containing five questions:

1. Emotional symptoms
2. Behavioral manifestations
3. Attention-deficit / hyperactivity disorder
4. Peer relationship problems
5. Prosocial behavior

Additionally, data on the child's mobile phone use, including average daily duration, and sleep patterns, including usual bedtime and wake-up time, were collected, whereas parental attention was evaluated based on whether parents spent time with the child on weekdays and weekends during the previous month.

### Scoring and Classification

Responses were scored according to established SDQ guidelines. The following cut-off values were used to classify outcomes as normal, borderline, or abnormal:

### Data Collection

Data were collected through interviewer-administered questionnaires conducted by trained field researchers. Mothers who provided informed consent evaluated their children's emotional and behavioral states using the SDQ as part of a broader structured interview.

### Statistical Analysis

Data were entered into a secured database and analyzed using Stata version 17.0 (StataCorp, College Station, TX, USA). Descriptive statistics were used to estimate the prevalence of emotional and behavioral difficulties. Associations between potential risk factors and SDQ outcomes were examined using chi-square tests, followed by univariable and multivariable multinomial logistic regression analyses to estimate odds ratios (ORs) with 95% confidence intervals (CIs). A p-value of less than 0.05 was considered statistically significant.

### Ethical Statements

Ethical approval for the study was obtained from the Institutional Review Board (IRB) of the Mongolian National University of Medical Sciences (IRB No. 20230217). Informed written consent for participation in the study was obtained from the parents or legal guardians of all participating children.

**Table 1.** Classification of Behavioral and Emotional Outcomes

Subscale	Normal	Borderline	Abnormal
Total difficulties	0–13	14-16	≥17
Emotional symptoms	0–3	4	≥5
Behavioral manifestation	0–2	3	≥4
Attention-deficit/hyperactivity disorder	0–5	6	≥7
Peer relationship problems	0–2	3	≥4
Prosocial behavior	6–10	5	0-4

## Results

A total of 781 children participated in the 2022 survey. Of these, 52.88% were male and 47.12% were female. The majority of participants (92.45%) resided in private or family

homes. Anthropometric assessment revealed that 31.24% of children were stunted, 8.83% were underweight, and 37.52% were overweight (Table 2).

**Table 2.** General characteristics of study participants.

Variables		Number (n)	Percent (%)
<b>Sex</b>	Male	413	52.88
	Female	368	47.12
<b>Region</b>	Orkhon, Burekhangai, Dashinchilen, Bayannuur	128	16.39
	Mogod, Gurvanbulag, Rashaant, Khishig-Öndör	166	21.25
	Selenge, Bugat, Khangal, Khyanganat	106	13.57
	Teshig, Khutag-Öndör, Saikhan, Bayan-Agt	101	25.74
	Bulgan sum	180	23.05
<b>Housing type</b>	Family home	298	38.16
	Private house	424	54.29
	Apartment	45	5.76
	Other	14	1.79
<b>Height</b>	Normal	443	56.72
	Stunted	244	31.24
	Above normal	94	12.04
<b>Weight</b>	Normal	324	41.49
	Underweight	69	8.83
	Overweight	388	49.68
<b>Body mass index</b>	Underweight	30	3.84
	Normal	197	25.22
	Overweight	261	33.42
	Obese	293	37.52

There were no statistically significant differences in emotional and behavioral manifestations by sex (Table 3). Although emotional and behavioral difficulties, prosocial behavior, and total

difficulties tended to be more prevalent among children living in the provincial centre, no statistically significant differences were observed (Table 4).

Table 3. Comparison of children's emotional and behavioral manifestations by sex.

Variables		Male n (%)	Female n (%)	p-value
<b>Emotional symptoms</b>	Normal	211 (51.09)	189 (51.36)	0.882
	Borderline	68 (16.46)	56 (15.22)	
	Abnormal	134 (32.45)	123 (33.42)	
<b>Behavioral manifestation</b>	Normal	222 (53.75)	204 (55.43)	0.860
	Borderline	75 (18.16)	62 (16.85)	
	Abnormal	116 (28.09)	102 (27.72)	
<b>Attention-deficit /hyperactivity disorder</b>	Normal	307 (74.33)	262 (71.20)	0.558
	Borderline	74 (17.92)	71 (19.29)	
	Abnormal	32 (7.75)	35 (9.51)	
<b>Peer relationship problems</b>	Normal	130 (31.48)	110 (29.89)	0.644
	Borderline	82 (19.85)	83 (22.55)	
	Abnormal	201 (48.67)	175 (47.55)	
<b>Prosocial behavior</b>	Normal	299 (72.40)	261 (70.92)	0.853
	Borderline	44 (10.65)	39 (10.60)	

p value was defined by Chi square test

Table 4. Comparison of children's emotional and behavioral manifestations by residence (sum vs provincial centre).

Variables		Sum n (%)	Provincial centre n (%)	p-value
<b>Emotional symptoms</b>	Normal	309 (51.41)	91 (50.56)	0.427
	Borderline	100 (16.64)	24 (13.33)	
	Abnormal	192 (31.95)	65 (36.11)	
<b>Behavioral manifestation</b>	Normal	341 (56.74)	85 (47.22)	0.051
	Borderline	104 (17.30)	33 (18.33)	
	Abnormal	156 (25.96)	62 (34.44)	
<b>Attention-deficit /hyperactivity disorder</b>	Normal	432 (71.88)	137 (76.11)	0.374
	Borderline	118 (19.63)	27 (15.00)	
	Abnormal	51 (8.49)	16 (8.89)	
<b>Peer relationship problems</b>	Normal	186 (30.95)	54 (30.00)	0.237
	Borderline	119 (19.80)	46 (25.56)	
	Abnormal	296 (49.25)	80 (44.44)	
<b>Prosocial behavior</b>	Normal	435 (72.38)	125 (69.44)	0.36
	Borderline	66 (10.98)	17 (9.44)	
	Abnormal	100 (16.64)	38 (21.11)	
<b>Total difficulties score</b>	Normal	36 (5.99)	11 (6.11)	0.408
	Borderline	83 (13.81)	18 (10.00)	
	Abnormal	482 (80.20)	151 (83.89)	

p value was defined by Chi square test

The prevalence of abnormal emotional symptoms was higher in Rashaant, Teshig, Khutag-Öndör, Selenge, Bayan-Agt, Orkhon, and Bulgan sums, while it was lower in Bayannuur and Khangal sums.

The prevalence of abnormal behavioral symptoms was higher in Mogod, Rashaant, and Orkhon sums, and lower in Bayannuur, Bugat, and Teshig sums.

The prevalence of attention-deficit/hyperactivity disorder symptoms was higher in Rashaant, Orkhon, Khutag-Öndör, and Dashinchilen sums, and lower in Bayannuur, Mogod, Saikhan, Teshig, Khangal, Selenge, and Bugat sums. The prevalence of abnormal peer relationship problems was higher in Mogod, Khangal, Rashaant, and Khutag-Öndör sums, and lower in Bugat and Saikhan sums. The prevalence of abnormal prosocial behavior was higher in Mogod and Bayan-Agt sums, and lower in Teshig, Bayannuur, Bugat, Rashaant, and Selenge sums.

Overall, the prevalence of abnormal emotional and behavioral symptoms was higher in Rashaant, Teshig, Mogod, and Orkhon sums, and lower in Bugat and Saikhan sums. The prevalence of

abnormal emotional and behavioral symptoms demonstrated a significant age-related increase throughout adolescence. Conversely, the proportion of children exhibiting abnormal attention-deficit/hyperactivity disorder and peer relationship problems showed a significant decline, stabilizing as students advanced through successive school grades. In contrast, the prevalence of abnormal prosocial behavior increased significantly with higher school grades. Overall, these findings indicate a developmental trend in which emotional and behavioral difficulties become more prominent with age, while hyperactivity and peer-related problems tend to diminish over time (Table 5).

**Table 5.** Age-related changes in the prevalence of children's emotional and behavioral symptoms.

Variables		2016 (%)	2019 (%)	2022 (%)	p-value
<b>Emotion</b>	Normal	73.07	73.26	51.22	0.001*
	Borderline	11.05	10.11	15.88	
	Abnormal	15.88	16.63	32.90	
<b>Behavior</b>	Normal	81.24	65.62	54.55	0.001*
	Borderline	10.77	18.76	17.54	
	Abnormal	7.99	15.62	27.91	
<b>Attention-deficit</b>	Normal	72.70	75.17	72.86	0.001*
	Borderline	13.00	17.64	18.57	
	Abnormal	14.30	7.19	8.57	
<b>Peer relationship</b>	Normal	26.56	32.02	30.73	0.001*
	Borderline	12.34	19.33	21.13	
	Abnormal	61.10	48.65	48.14	
<b>Prosocial behavior</b>	Normal	96.94	67.75	71.70	0.001*
	Borderline	1.39	14.27	10.63	
	Abnormal	1.67	17.98	17.67	
<b>Emotional and behavioral manifestations</b>	Normal	4.18	4.94	6.02	0.001*
	Borderline	13.93	23.26	12.93	
	Abnormal	81.89	71.80	81.05	

\* statistical significance, p value was defined by Chi square test

Parental attention quality, excessive mobile phone use, and reduced sleep duration were significantly associated with abnormal emotional and behavioral symptoms. Specifically, lower levels of parental attention and increased mobile phone use were linked to a higher likelihood of abnormal scores across all domains, including emotional symptoms, behavioral

manifestations, attention-deficit/hyperactivity disorder, peer relationship problems, and prosocial behavior. Furthermore, reduced sleep duration was independently associated with elevated risks of both emotional and behavioral difficulties (Table 6).

**Table 6.** Factors associated with abnormal emotional and behavioral manifestations.

Variables		Normal n (%)	Borderline n (%)	Abnormal n (%)	p-value
<b>Emotion</b>					
Sleep deprivation	Yes	104 (26)	32 (25.81)	68 (26.46)	0.988
Parental caregiving	Yes	212 (53)	63 (50.81)	100 (38.91)	0.002*
Mobile phone use	Yes	48 (12)	27 (21.77)	58 (22.57)	0.001*
<b>Behavioral manifestation</b>					
Sleep deprivation	Yes	113 (26.53)	35 (25.55)	56 (25.69)	0.96
Parental caregiving	Yes	221 (51.88)	64 (46.72)	90 (41.28)	0.037*
Mobile phone use	Yes	43 (10.09)	24 (17.52)	66 (30.28)	0.001*
<b>Attention-deficit</b>					
Sleep deprivation	Yes	154 (27.07)	31 (21.38)	19 (28.36)	0.345
Parental caregiving	Yes	285 (50.09)	63 (43.45)	27 (40.3)	0.15
Mobile phone use	Yes	92 (16.17)	21 (14.48)	20 (29.85)	0.013*
<b>Peer relationship problems</b>					
Sleep deprivation	Yes	66 (27.5)	39 (23.64)	99 (26.33)	0.679
Parental caregiving	Yes	131 (54.58)	77 (46.67)	167 (44.41)	0.045*
Mobile phone use	Yes	29 (12.08)	22 (13.33)	82 (21.81)	0.003*
<b>Prosocial behavior</b>					
Sleep deprivation	Yes	113 (26.53)	39 (23.64)	19 (28.36)	0.47
Parental caregiving	Yes	290 (51.79)	33 (39.76)	52 (37.68)	0.003*
Mobile phone use	Yes	78 (13.93)	21 (25.3)	34 (24.64)	0.001*
<b>Emotional and behavioral manifestations</b>					
Sleep deprivation	Yes	20 (42.55)	26 (25.74)	158 (24.96)	0.03*
Parental caregiving	Yes	29 (61.7)	64 (63.37)	282 (44.55)	0.001*
Mobile phone use	Yes	3 (6.38)	12 (11.88)	118 (18.64)	0.033*

\* statistical significance, p value was defined by Multivariable multinomial logistic regression

### Potential Risk Factors Associated with SDQ Outcomes

Multinomial logistic regression analysis identified several significant risk factors associated with emotional and behavioral difficulties among adolescents (Table 7).

Reduced parental attention was significantly associated with an increased risk of abnormal emotional symptoms (adjusted relative risk ratio [aRRR] = 1.77; 95% confidence interval [CI]: 1.28–2.43). Similarly, increased mobile phone use was associated with both borderline (aRRR = 2.04; 95% CI: 1.21–3.44) and abnormal (aRRR = 2.13; 95% CI: 1.40–3.25) levels of emotional symptoms.

For behavioral manifestation, reduced parental attention increased the risk of abnormal outcomes (aRRR = 1.53; 95% CI: 1.10–2.13), whereas increased mobile phone use was a significant risk factor for both borderline (aRRR = 1.89; 95% CI: 1.10–3.25) and abnormal (aRRR = 3.86; 95% CI: 2.52–5.93) behavioral manifestation. Increased mobile phone use also predicted a higher likelihood of abnormal attention-deficit/

hyperactivity disorder (aRRR = 2.20; 95% CI: 1.24–3.89).

Abnormal peer relationship problems were associated with both increased mobile phone use (aRRR = 2.02; 95% CI: 1.28–3.21) and reduced parental attention (aRRR = 1.50; 95% CI: 1.08–2.08). In addition, reduced parental attention was linked to borderline (aRRR = 1.62; 95% CI: 1.01–2.60) and abnormal (aRRR = 1.77; 95% CI: 1.21–2.60) prosocial behavior, while increased mobile phone use was a risk factor for both borderline (aRRR = 2.09; 95% CI: 1.20–3.62) and abnormal (aRRR = 2.02; 95% CI: 1.28–3.18) prosocial outcomes. Sleep deprivation was independently associated with higher odds of borderline (aRRR = 2.13; 95% CI: 1.02–4.43) and abnormal (aRRR = 2.22; 95% CI: 1.21–4.08) total difficulties scores. Furthermore, both reduced parental attention (aRRR = 2.00; 95% CI: 1.09–3.68) and increased mobile phone use (aRRR = 3.36; 95% CI: 1.02–11.00) emerged as independent predictors of abnormal total difficulties scores.

**Table 7.** Risk factors influencing abnormal emotional and behavioral manifestations.

Variables		aRRR	p-value	95% CI		aOR	p-value	95% CI	
				Lower	Upper			Lower	Upper
<b>Emotion</b>									
Parental caregiving	Normal	ref				ref			
	Borderline	1.09	0.669	0.72	1.63	1.48	0.008*	1.11	1.99
	Abnormal	1.77	0.001*	1.28	2.43				
Mobile phone use	Normal	ref				ref			
	Borderline	2.04	0.007*	1.21	3.44	2.12	0.001*	1.42	3.16
	Abnormal	2.13	0.001*	1.4	3.25				
<b>Behavior</b>									
Parental caregiving	Normal	ref				ref			
	Borderline	1.22	0.293	0.83	1.8	1.43	0.016*	1.07	1.93
	Abnormal	1.53	0.011*	1.1	2.13				
Mobile phone use	Normal	ref				ref			
	Borderline	1.89	0.021*	1.1	3.25	2.96	0.001*	1.97	4.44
	Abnormal	3.86	0.001*	2.52	5.93				
<b>Attention-deficit /hyperactivity disorder</b>									
Mobile phone use	Normal	ref				ref			
	Borderline	0.87	0.62	0.52	1.46	1.24	0.295	0.82	1.86
	Abnormal	2.2	0.006*	1.24	3.89				
<b>Peer relationship</b>									
Parental caregiving	Normal	ref				ref			
	Borderline	1.37	0.118	0.92	2.04	1.43	0.026*	1.04	1.96
	Abnormal	1.5	0.014*	1.08	2.08				
Mobile phone use	Normal	ref				ref			
	Borderline	1.11	0.71	0.61	2.02	1.74	0.016*	1.11	2.74
	Abnormal	2.02	0.003*	1.28	3.21				
<b>Prosocial behavior</b>									
Parental caregiving	Normal	ref				ref			
	Borderline	1.62	0.042*	1.01	2.6	1.75	0.001*	1.26	2.44
	Abnormal	1.77	0.003*	1.21	2.6				
Mobile phone use	Normal	ref				ref			
	Borderline	2.09	0.008*	1.2	3.62	2.05	0.001*	1.37	3.06
	Abnormal	2.02	0.002*	1.28	3.18				
<b>Emotional and behavioral manifestations</b>									
Sleep deprivation	Normal	ref				ref			
	Borderline	2.13	0.042*	1.02	4.43	2.24	0.012*	1.19	4.21
	Abnormal	2.22	0.01*	1.21	4.08				
Parental caregiving	Normal	ref				ref			
	Borderline	0.93	0.845	0.45	1.9	1.8	0.049*	1.38	3.31
	Abnormal	2	0.025*	1.09	3.68				
Mobile phone use	Normal	ref				ref			
	Borderline	1.97	0.31	0.53	7.37	3.15	0.048*	1.03	10.32
	Abnormal	3.36	0.045*	1.02	11				

\* statistical significance, p value was defined by Multivariable multinomial logistic regression

Results from the multivariable multinomial logistic regression analysis identified several significant predictors of emotional and behavioral difficulties among adolescents (Table 8). Borderline emotional symptoms were significantly associated with increased

mobile phone use (adjusted relative risk ratio [aRRR] = 2.03; 95% confidence interval [CI]: 1.20–3.43).

Table 8. Multivariable Risk Factors Influencing Abnormal Emotional and Behavioral Symptoms.

Variables		aRRR	p-value	95% CI		aOR	p-value	95% CI	
				Lower	Upper			Lower	Upper
<b>Emotional Symptoms</b>									
Parental care	Normal	ref				ref			
	Borderline	1.04	0.83	0.69	1.56				
Mobile phone use	Borderline	2.03	0.008*	1.2	3.43				
Parental care	Abnormal	1.69	0.001*	1.22	2.33	1.44	0.012*	1.08	1.92
	Abnormal	2.01	0.001*	1.32	3.08	2.02	0.001*	1.37	2.98
<b>Behavioral Manifestation</b>									
Parental care	Normal	ref				ref			
	Borderline	1.19	0.372	0.8	1.75				
Mobile phone use	Borderline	1.85	0.026*	1.07	3.19				
Parental care	Abnormal	1.41	0.046*	1.006	1.98	1.31	0.06	0.98	1.76
	Abnormal	3.73	0.001*	2.42	5.73	2.93	0.001*	1.97	4.36
<b>Peer relationship</b>									
Parental care	Normal	ref				ref			
	Borderline	1.36	0.124	0.91	2.03				
Mobile phone use	Borderline	1.07	0.8	0.59	1.95				
Parental care	Abnormal	1.44	0.029*	1.03	2	1.41	0.026*	1.04	1.92
	Abnormal	1.94	0.005*	1.22	3.08	1.66	0.025*	1.06	2.59
<b>Prosocial behavior</b>									
Parental care	Normal	ref				ref			
	Borderline	1.55	0.068	0.96	2.49				
Mobile phone use	Borderline	1.99	0.014*	1.14	3.47				
Parental care	Abnormal	1.7	0.007*	1.15	2.5	1.64	0.002*	1.19	2.26
	Abnormal	1.9	0.006*	1.2	3.02	1.94	0.001*	1.31	2.87
<b>Emotional and behavioral manifestations</b>									
Sleep deprivation	Normal	ref				ref			
	Borderline	2.18	0.042*	1.02	4.43				
Parental care	Borderline	0.95	0.905	0.46	1.96				
	Borderline	2.13	0.262	0.56	7.99				
Sleep deprivation	Abnormal	2.45	0.004*	1.32	4.53	2.4	0.005*	1.3	4.42
	Abnormal	2.01	0.025*	1.09	3.74	1.81	0.046*	1.08	3.34
Mobile phone use	Abnormal	3.36	0.047	1.01	11.09	3.17	0.048*	1.06	10.44

\* statistical significance, p value was defined by Multinomial logistic regression

Abnormal emotional symptoms were associated with both reduced parental attention (aRRR = 1.69; 95% CI: 1.22–2.33) and increased mobile phone use (aRRR = 2.01; 95% CI: 1.32–3.08).

In relation to behavioral manifestation, borderline behavioral manifestation were linked to increased mobile phone use (aRRR = 1.85; 95% CI: 1.07–3.19), whereas abnormal behavioral manifestation were associated with reduced parental attention (aRRR = 1.41; 95% CI: 1.01–1.98) and increased mobile phone use (aRRR = 3.73; 95% CI: 2.42–5.73).

Abnormal peer relationship problems were significantly associated with both reduced parental attention (aRRR = 1.44;

95% CI: 1.03–2.00) and increased mobile phone use (aRRR = 1.94; 95% CI: 1.22–3.08).

Regarding prosocial behavior, borderline prosocial difficulties were associated with increased mobile phone use (aRRR = 1.99; 95% CI: 1.14–3.47), while abnormal prosocial behavior was linked to reduced parental attention (aRRR = 1.70; 95% CI: 1.15–2.50) and increased mobile phone use (aRRR = 1.90; 95% CI: 1.20–3.02). For emotional and behavioral manifestations, borderline total difficulties were associated with reduced sleep duration (aRRR = 2.18; 95% CI: 1.02–4.43). Abnormal total difficulties were significantly related to reduced sleep duration (aRRR = 2.45; 95% CI: 1.32–4.53), reduced parental attention

(aRRR = 2.01; 95% CI: 1.09–3.74), and increased mobile phone use (aRRR = 3.36; 95% CI: 1.01–11.09).

## Discussion

Parental reports indicated that 32.52% of children experienced anxiety when exposed to unfamiliar environments, 19.33% exhibited fear toward multiple stimuli, and 17.03% frequently felt worried or anxious across various situations. These findings are consistent with those reported by Bayarmaa, et al. on adolescent emotional and behavioral problems in Mongolia, although the prevalence observed in the present cohort was notably higher.<sup>6</sup>

With respect to behavioral symptoms, 24.2% of children were generally described as obedient, whereas 14.6% displayed frequent temper outbursts patterns comparable to those reported in previous studies. In contrast, attention-deficit/hyperactivity disorder was considerably more prevalent in this cohort, with 62.61% of children characterized as persistently active or unstable, exceeding the proportions found in earlier research. Regarding prosocial behavior, 61.84% of participants were described as gentle toward younger children, and 57.87% were reported to share with peers both figures surpassing those documented in prior studies.<sup>6</sup>

The findings of poor parental attention and excessive mobile phone use found in our study are similar to those found in a systematic review by researcher Xiaoxuan Liu, et al.<sup>11</sup> Another study, a systematic review, examined the relationship between parental inattention and children's mobile phone use and behavior, which is similar to our study.<sup>12</sup> Researcher Rosalind D Butterfield, et al. have found that parental care/good relationships have a protective effect on adolescent psychology and behavior.<sup>13</sup> Pauline Billaux, et al.'s study found that poor family relationships have a negative impact on sleep quality and psychological well-being in adolescents, and concluded that parental role models are more important than children's mobile phone use.<sup>14</sup> Research by researcher Leilei Cao, et al. found that sleep quality is inversely correlated with aggressive behavior, with poorer sleep quality leading to increased negative behavior.<sup>15</sup> Research has also shown that children who sleep less than 7 hours are more likely to engage in risky behaviors, suggesting that children need to increase their sleep time.<sup>16</sup> A meta-analysis of a longitudinal study found that not only does sleep deprivation affect behavior,

but behavioral problems can also affect sleep.<sup>17</sup> Research by Sakari Lemola, et al. found that looking at a mobile phone at night disrupts sleep quality and can lead to depression.<sup>18</sup> Some researchers have also found that excessive phone use may increase psychological and behavioral risks by disrupting sleep, which is similar to our study.<sup>19</sup> A study of 10,220 adolescents in Norway found that sleep problems can lead to self-harm and serious psychological problems, indicating that adolescents need special attention.<sup>20</sup> In addition, many studies around the world have shown that sleep quality is clearly associated with many negative psychological changes and risky behaviors, which is a similar conclusion to our research.<sup>21–24</sup>

These findings highlight an elevated prevalence of emotional and behavioral manifestations among adolescents in Bulgan Province compared to earlier national and regional data. The observed differences may reflect variations in measurement periods, sociocultural environments, or the evolving influence of digital device use and sleep-related factors on child behavior. Therefore, it is necessary to conduct specific training campaigns and implement measures to increase the quality of sleep among adolescents, improve family involvement, and reduce mobile phone use.

Given the relative paucity of research on adolescent emotions and behavior in the health sector, especially in rural areas, this study provides an opportunity to conduct a cohort study in Bulgan aimag and other localities. It is hoped that the results of this study will contribute to identifying risk factors, developing targeted programs to promote maternal and child health, and providing evidence-based information for policy planning aimed at improving the quality and accessibility of health services. These results contribute significantly to the development of innovative approaches and methodologies for developing updated policies to support adolescent health, not only in the region but also across the country, and are of practical importance as examples for expanding the application of this research methodology in the future. Moreover, follow-up assessments of the study participants at ages 15 and 18 are feasible and would allow for the generation of more detailed findings.

When determining the sample size, the total target population was estimated to be 1,100 people, and approximately 880 participants were planned to be included in the study with a sampling rate of 80%. This sample size was sufficient to provide the statistical power required for multivariate analysis and was

calculated at a confidence level of 95% and a margin of error of 5%. It was also planned to provide a reserve to account for attrition during the study. The sample selection was planned to be conducted using a random sampling method in accordance with the study objectives, which will allow the study results to be generalized to the population of mothers with children born in Bulgan aimag in 2010. The study sample was organized to ensure geographical representation and gender balance by including mothers and children born in all soums of the aimag.

During the preparation for the survey, midwives and pediatricians from each health institution were trained, and a surveyor and coordinator were employed to collect data. 2 primary care providers operating in the province, 2 from each of the 16 soum health centers, 5 midwives from the maternity ward of the province's General Hospital, and 5 specialists from the Department of Health attended a 3-day training course, where they were informed about the research objectives, research methodology, researcher ethics, and potential issues at the time. Experts with good knowledge of the living conditions of the local people, the area, and the study participants were selected as researchers.

The research funding and researchers were relatively stable, and training was organized every time the researcher moved. While 1016 children were initially included in the study, in 2022, 795 / 12 years old / children were accompanied by 219 children who moved to another community, and 2 children died, which was a limitation of the study. The study was stable because each study had a fixed funding source, was led by consistent local staff and a coordinator, and the main limitation was family migration. These findings underscore that at the family level, parents should engage in regular communication with their children, listen attentively, spend quality time together, seek guidance from child psychologists when necessary, and support their children's interests. At the school and policy makers' level, programs should be implemented to reduce children's mobile phone use, promote sports and physical activity, foster healthy behaviors, strengthen relationships among parents, teachers, and children, and establish centers that support productive use of leisure time.

## Conclusion

Lack of parental attention, reduced sleep duration, and higher mobile phone usage are significant factors influencing abnormal

emotional and behavioral manifestations among adolescents.

## Conflict of Interest

The authors state no conflict of interest.

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