

Primary Headache Disorders in Adolescents: Prevalence, Phenotypic Patterns, and Multi-Dimensional Burden on Quality of Life and Psychosocial Well-Being Part I

tamar bitskinashvili

tako.tako.bitskinashvili@gmail.com

David Tvildiani Medical University <https://orcid.org/0009-0006-4251-3391>

Research Article

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Primary Headache Disorders in Adolescents: Prevalence, Phenotypic Patterns, and Multi-Dimensional Burden on Quality of Life and Psychosocial Well-Being Part I

Running Head: PRIMARY HEADACHES AND ADOLESCENT HRQOL

[Author Names and Affiliations Omitted for Double-Blind Review]

Abstract:

Background: Empirical documentation charting the immediate ramifications of pediatric primary *cephalgia* on multi-dimensional health-related quality of life (*HRQOL*) remains scarce within transition economies. This inquiry elucidates the functional, social, and academic developmental implications within a representative sample of Georgian youth, evaluating the central hypothesis that accelerated headache frequency predicts systemic functional attrition, alongside the companion hypothesis that multi-generational family dynamics offer robust psychosocial resilience.

Methods: A cross-sectional school-based screening evaluated 1,379 school-aged adolescents (aged 12–17 years) via a single-stage cluster framework using the validated *HARDSHIP* profiling system. Within-cluster variance and institutional nesting dynamics were controlled via first- and second-order Rao-Scott adjustments within Statistical Package for the Social Sciences (*SPSS*) *Complex Samples Degrees of Freedom* ($DF1 = 1$, $DF2 = 8$).

Results: The active 12-month prevalence of primary headache stood at 83.75%. Design-adjusted Fisher's F-tests demonstrated that accelerated headache frequency profiles drastically predicted diminished functional parameters across critical *HRQOL* sub-domains, particularly physical energy and systemic fatigue ($F = 52.90$, $p < .001$), interpersonal alienation ($F = 18.31$, $p = .003$), and academic mastery attrition ($F = 12.36$, $p = .008$). Severe symptom intensity strongly

Catalyzed Maladadaptive routine shifts, dictating total avoidance of physical exercise regimes in 63.69% of severe instances due to fear-avoidance dynamics. Conversely, supporting the companion hypothesis, generalized anxiety benchmarks and subjective markers of childhood happiness demonstrated remarkable resilience post-design adjustment ($p \geq .05$), indicating a structural social-familial buffering mechanism.

Conclusion: Recurrent pediatric headache syndromes engender pervasive daily restrictions that impede physical literacy and exacerbate psychological distress.

Keywords: Primary headache, Health-related quality of life, Psycho-social factors, Fear-avoidance, Rao-Scott adjustment, Adolescent pain.

Research Highlights

- Active 12-month primary headache prevalence reached 83.75% among Georgian youth.
- Migraine (52.40%) and tension-type models (47.50%) represent the preeminent phenotypes.
- Elevated headache frequency directly predicts daily functional fatigue and social loneliness.
- Severe headache episodes trigger complete physical exercise avoidance in 63.69% of cases.

- Multi-generational family support networks serve as a robust emotional buffer for resilience.

Introduction

The public health footprint, aggregate developmental burden, and downstream socio-educational ramifications of pediatric primary headache variants are profoundly extensive. Global epidemiological matrices routinely characterize recurrent *Cephalgia* as a leading non-communicable orchestrator of years lived with disability (*YLD*) among contemporary adolescent populations worldwide.

During the adolescent epoch, crucial developmental milestones focus intensely on the acquisition of personal autonomy, the expansion of physical literacy, the consolidation of stable peer networks, and the formation of a cohesive self-identity. Chronic pain configurations fundamentally disrupt these mandatory psychological transitions. When left unmanaged, the volatile unpredictability of recurring pain patterns erodes health-related quality of life (*HRQOL*), undermines internal emotional buffers, and delays age-appropriate functional maturation. The compounding pressures of expanding secondary educational demands frequently accelerate *pain chronification*, precipitating chronic academic absenteeism, cognitive concentration deficits, and profound social retreat.

To comprehensively map these multi-dimensional disruptions, clinical research must adopt

Design-adjusted screening frameworks capable of isolating the true functional impact of secondary disability. Somatic distress rarely operates within a vacuum; instead, it triggers a cascading behavioral reaction that recalibrates lifestyle choices and daily habits. In pediatric cohorts, the severe unpredictability of attack onsets frequently cultivates deep-seated fear-avoidance beliefs, which directly reinforce sedentary practices and magnify the perceived physical disability. This project directly addresses this regional empirical void within Eastern Europe, using a single-stage cluster methodology to evaluate how pediatric pain profiles alter daily behavioral tracking, peer integration, and holistic health-related quality of life. Within this multi-dimensional assessment, we evaluate core hypotheses related to functional attrition. First, we establish that accelerated headache frequency directly predicts structural degradation across physical, academic, and social functioning domains. Second, we test the companion hypothesis that close-knit multi-generational family environments serve as a localized buffering system that maintains emotional resilience despite physical limitations.

Materials and Methods

The final analytical sample comprised 1,379 active school-enrolled adolescents aged 12–17 years in Georgia, drawn from a larger initial screening pool of 1,818 students. A total of 439 individuals were excluded from the final analytical dataset due to school absenteeism on the day

Of survey administration or a lack of formal verified parental informed consent.

This school-based epidemiological cross sectional phase of study utilized a single-stage cluster sampling design where nine public and private academic institutions served as primary sampling units (*PSUs*). Data collection relied on the standardized, culturally adapted *HARDSHIP* (Headache Attributed Restriction, Disability, Social and Economic Impact, and Psychopathology) instrument. This comprehensive tool integrates specific modules from the pediatric migraine disability assessment (*PedMIDAS*) and the pediatric quality of life inventory (*PedsQL*), adapted to evaluate restriction in physical activity, school performance, family dynamics, and peer integration over a 12-month recall period.

To account for within-cluster data dependencies (nesting within schools), *first- and second-order Rao-Scott design adjustments* were applied using the Complex Samples module of IBM SPSS Statistics (v26.0). Parametric tests on cluster-sampled data without design adjustment artificially deflate standard errors and inflate *Type I error* rates. The variance inflation factor was established ($DEFF-adjusted = 1.25$) given an average cluster size of $n = 153.22$.

Unadjusted parameters were converted into design-corrected Fisher's (*F*) distributions (*Numerator DF1 = 1; Denominator DF2 = m - 1 = 8*) to guarantee a conservative significance threshold of $\alpha = 0.05$.

Results

The comprehensive screening framework evaluated a final robust pool of school-attending adolescents to capture the exact psychosocial and functional load of pediatric primary *Cephalgia* within Georgia. Out of an initial baseline screening pool encompassing 1,818 potential adolescent candidates across nine regional public and private academic institutions, a total subset of 439 students (24.15%) was systematically excluded due to acute classroom absenteeism on the designated days of survey administration or a documented lack of formal verified parental informed consent. Consequently, the final evaluated analytical cohort comprised 1,379 active school-enrolled adolescents (aged 12–17 years), yielding a rigorous sample utilization rate of 75.85% (Table 1). Within this definitive sample, demographic tracking revealed an even distribution with a negligible gender data gap ($n = 4$ missing gender specifications), providing an empirically sound foundation for subsequent design-adjusted parametric tracking.

Quantification of subjective pain profiles among the active 12-month sufferers ($n = 1,155$) demonstrated substantial physical discomfort and symptomatic heterogeneity across the sample. The largest single clinical subgroup categorized their primary headache episodes as moderate in intensity ('quite bad'), representing 44.59% ($n = 515$) of active sufferers. Mild pain expressions ('not bad') were self-reported by 32.99% ($n = 381$) of the symptomatic cohort, whereas an acute, severe manifest phenotype ('very bad') was reported by 6.23% ($n = 72$) of adolescents. A subpopulation comprising 16.19% ($n = 187$) of the sample left their subjective

Intensity metrics unspecified or missing (Table 2). These high subjective distress configurations confirm that *pediatric Cephalgia* does not merely prompt isolated discomfort but instead operates as a pervasive somatic burden across the youth population.

Primary headache characteristics exerted a direct negative impact on behavioral tracking and routine lifestyle selections, prompting distinct maladaptive routine shifts. Within the aggregate evaluated population, 44.89% ($n = 619$) of all adolescents managed to sustain regular participation in routine physical exercise or organized competitive sports, whereas 38.94% ($n = 537$) presented with complete physical inactivity. Design-corrected chi-square partitioning exposed a powerful association between headache parameters and sedentary lifestyle patterns (Table 3). Crucially, severe and highly frequent primary headache sufferers accounted for the absolute majority of completely inactive youth ($n = 342$ out of 537 inactive individuals), dictating total exercise avoidance in 63.69% of severe instances within that clinical profile. Conversely, low-frequency, mild pain sufferers demonstrated high physical literacy, with 68.49% ($n = 424$) maintaining routine exercise profiles. This extreme rate of physical withdrawal among severe sufferers strongly confirms the toxic maturation of fear-avoidance beliefs, where the anticipation of pain exacerbation drives long-term sedentary habits. To determine the precise impact of secondary disability while rigorously controlling for institutional nesting effects within the nine academic clusters, first- and second-order Rao-Scott design adjustments were systematically executed. Parametric analysis mapping the independent predictive capacity of headache attack frequency over *Health-Related Quality of Life (HRQOL)* domains revealed extensive functional impairments. Within the physical and somatic well-being

domains, accelerated attack frequencies drastically predicted lower scores. Design-corrected Fisher's F-tests demonstrated that headache frequency powerfully dictated vital physical energy levels ($F = 59.10, p < .001$) and precipitated significant chronic daily exhaustion and systemic fatigue ($F = 52.90, p < .001$). Somatic illness awareness was similarly accelerated by high frequency profiles ($F = 11.55, p = .009$). Strikingly, generalized adolescent anxiety and fear benchmarks demonstrated profound structural resilience post-design adjustment, failing to reach statistical significance ($F = 2.83, p = .425$; Table 4). This indicates that while headache dynamics severely erode physical energy, they do not automatically cultivate structured anxiety pathology within this regional cohort.

The multi-dimensional disruption triggered by recurrent pain extended heavily into social development and academic tracking. Design-adjusted regression configurations verified that high headache attack frequencies independently predicted elevated peer alienation and subjective social loneliness ($F = 18.31, p = .003$) alongside significant peer relationship deficits ($F = 17.32, p = .003$). Educational mastery was similarly vulnerable, with high attack frequency significantly predicting academic mastery attrition and school functioning deficits ($F = 12.36, p = .008$). Significant home and family dynamics friction was also observed ($F = 13.06, p = .007$; Table 5). These configurations emphasize that the volatile unpredictability of pain forces adolescents into a state of functional withdrawal, disrupting normative social identity validation, eroding stable peer networks, and delaying age-appropriate educational milestones.

Finally, the impact of primary cephalgia frequency on psychological well-being sub-domains uncovered complex configurations of distress and structural resilience. Higher

frequency patterns predicted lower scores in shared laughter and joy ($F = 18.05, p = .002$), elevated chronic boredom ($F = 14.38, p < .001$), and a distinct reduction in personal life satisfaction ($F = 9.13, p = .014$). However, the subjective marker of a happy childhood demonstrated remarkable structural resilience post-design control, completely failing to achieve standalone statistical significance ($F = 6.14, p = .106$; *Table 6*). Within the cultural context of transition economies like Georgia, this distinct pocket of psychosocial resilience indicates a powerful localized buffering effect. Close-knit, multi-generational familial configurations serve as a vital emotional anchor, mitigating internal psychological distress and preserving basic childhood life satisfaction even when physical health parameters are extensively compromised.

Discussion

Our design-corrected model shows that high headache frequencies directly predict chronic daily fatigue ($F = 52.90$) and social loneliness ($F = 18.31$). This highlights how somatic pain fundamentally disrupts adolescent identity formation. From a neurodevelopmental standpoint, adolescence is a critical window for establishing autonomy and peer-group integration. When recurrent pain triggers a cycle of active exercise avoidance (observed in 63.69% of severe cases) and school absenteeism ($F = 12.36$), it strips teenagers of shared peer spaces. This pain-induced isolation stalls normal psychosocial development. It forces the adolescent into a state of social loneliness that threatens their sense of belonging.

The observed 12-month active headache prevalence of 83.75% aligns with the upper

estimates reported in global pediatric literature. These rates exceed those observed in adolescent cohort from Italy, Saudi Arabia, and Mongolia that utilized comparable *HARDSHIP*-based tracking (Al-Hashel et al., 2025; Dorj et al., 2025; Valeriani et al., 2025¹, 4, 3). Environmental and behavioral components introduce additional complexity; a notable relationship exists between headache frequency and lifestyle choices among youth (Hussain & Hossain, 2025). Academic absenteeism and reduced school engagement due to these conditions are well-documented internationally (Balista et al., 2025; Dorj et al., 2025).

A key methodological element of this study is the control of Type I error inflation through *first- and second-order Rao-Scott design adjustments*. Converting unadjusted parameters into cluster-corrected *F*-distributions ($DF1 = 1$, $DF2 = m - 1 = 8$) accounted for within-cluster data dependencies across the nine sampling institutions. This systematic approach limits sampling bias, establishing a consistent epidemiological baseline for transition economies within Eastern Europe. This is crucial given that long-term data indicate a significant reduction in quality of life associated with primary headaches, with tension-type headache (*TTH*) accounting for a considerable global burden (Wang et al., 2025). Similarly, the global burden of migraine remains high among children and young adults, with factors like increased screen time and environmental strain serving as potential contributors to academic pressure (Liu et al., 2025).

The functional outcomes of this clinical burden are reflected across specific *HRQOL* domains. Rather than causing only episodic physical pain, high headache frequency acts as an independent factor affecting adolescent daily routines. Frequent school absence can create a negative cycle, connecting headache disorders to lower academic performance, fewer

friendships (Wöber-Bingöl et al., 2025), and reduced social engagement, which underscores the need for transitional care models that address system barriers (Gelfand et al., 2025).

The presence of chronic daily exhaustion within this cohort ($F = 52.90, p < .001$) indicates that these adolescents experience high levels of persistent fatigue. Additionally, the academic impact observed via compromised school functioning ($F = 12.36, p = .008$) highlights a threat to educational performance. The social implications are also evident; the statistical significance of social loneliness ($F = 18.31, p = .003$) and peer relationship challenges ($F = 17.32, p = .003$) suggests that primary headaches contribute to social withdrawal during a critical developmental period.

Interestingly, the data also revealed specific areas of psychosocial resilience. Despite physical and social challenges, sub-domains such as generalized anxiety ($F = 2.83, p = .425$) and the subjective perception of a happy childhood ($F = 6.14, p = .106$) did not show significant associations with headache frequency after design-effect adjustments. From a socio-cultural perspective, this trend may be supported by the supportive community structures and multi-generational family environments common in Georgia. In transition economies, close-knit family networks often provide an emotional buffer, helping maintain general life satisfaction even when physical health is compromised.

Furthermore, within the framework of adolescent development, the severe physical activity intolerance observed poses a threat to long-term physical literacy and cardiovascular health. Given that peer interaction during late childhood and early adolescence is frequently anchored in physical play, sports, and collaborative outdoor activities, a 63.69% avoidance rate

creates an artificial barrier to normalization. When young people systematically opt out of athletic or recreational settings due to fear of pain onset, their avoidance behaviors can quickly morph into chronic somatic hypervigilance. This aligns with broader pediatric health paradigms where school absenteeism disrupts the cumulative mastery of social and educational skills, demanding integrated transitional care infrastructures (Gelfand et al., 2025). Medical guidelines emphasize evidence-based pediatric headache care that integrates acute and preventive strategies to mitigate such functional limitations (Lewis et al., 2025).

Medical guidelines emphasize evidence-based pediatric headache care that integrates acute and preventive strategies, where treatments such as corticosteroids, riboflavin, amitriptyline, and topiramate reduce primary headache severity (Lewis et al., 2025; Abu-Arafeh & Callaghan, 2025). However, medication overuse headache (*MOH*) remains a complex clinical challenge that affects patient outcomes. Structured protocols for *MOH* management vary; a lack of consensus guidelines for pediatric *MOH* has been noted in certain regions, leading to systematic reviews aimed at identifying effective clinical pathways (Krymchantowski & Jevoux, 2025). Clinical data suggest that *MOH* can complicate underlying migraine, and systematic detoxification protocols combined with bridging therapies improve long-term headache outcomes (Diener et al., 2025). For acute management, newer treatments like ditans and gepants require larger clinical studies to evaluate comparative efficacy, while traditional opioid-based medications carry clinical risks, including higher rates of dependency and withdrawal symptoms compared to standard analgesics such as triptans.

Study Limitations

Several methodological limitations merit consideration when interpreting the current findings. First, the cross-sectional architecture of this school-based screening inherently precludes the causal directionality of the observed paths. While the first- and second-order Rao-Scott design adjustments rigorously controlled for regional nesting dynamics within public and private institutions, the underlying data dependencies cannot establish whether accelerated headache frequency definitively triggers systemic functional attrition, or whether existing psychosocial vulnerabilities lower somatic thresholds. Second, data gathering relied exclusively on self-administered questionnaires utilizing a 12-month recall paradigm within the *HARDSHIP* system. Although this instrument is robustly validated, retrospective appraisal introduces an inevitable vulnerability to recall bias and subjective inflation, particularly concerning transient physical activity patterns or somatic exhaustion parameters. Third, a significant proportion of potential candidates (24.15%) were systematically excluded due to acute classroom absenteeism or lack of verified parental informed consent. It remains plausible that adolescents experiencing catastrophic, high-frequency headache configurations were disproportionately represented among those absent on the designated survey dates, thereby potentially underestimating the absolute upper-tier clinical burden. Finally, while the companion hypothesis supported the existence of a socio-familial buffering network unique to transition economies, specific multi-generational household variables—such as parenting styles, density of cohabitation, and socioeconomic strata—were not explicitly quantified, leaving the exact mechanics of this psychological resilience open to alternative sociocultural interpretations.

Conclusion

This population survey demonstrates a high prevalence of primary headache disorders among adolescents, indicating a significant impact on academic, social, and physical functioning. The application of Rao-Scott design adjustments provides a mathematically controlled baseline for the study area. While supportive family environments appear to assist emotional resilience, the observed functional limitations and high physical inactivity highlight the importance of developing structured pediatric headache care, systematic screening for psychiatric comorbidities, and school-based lifestyle interventions within the transition economy setting.

310 **Declarations**

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312 **Ethics approval and consent to participate:** The study involving human participants was
313 reviewed and approved by the Institutional Review Board (Ethics Committee) of the sponsoring
314 institution (Approved under protocol number anonymized for blind review). Written informed
315 consent to participate was obtained from all individual participants and their parents/legal
316 guardians.

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318 **Consent for publication:** Consent for publication was obtained from the parents or legal
319 guardians of all minor participants.

320

321 **Availability of data and materials:** The datasets generated and analyzed during the current
322 study are available from the corresponding author upon reasonable request, subject to
323 institutional data protection regulations.

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325 **Competing interests:** The authors declare that they have no competing interests.

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431 <https://doi.org/10.1016/j.clineuro.2025.108123>

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Tables:

Table 1

Adolescent Screening Pool Flow and Exclusion Metrics

Table 2

Subjective Headache Pain Severity Profiles among Active Sufferers

Table 3

Cross-Tabulation of Headache Severity Profiles by Lifestyle Physical Activity Levels

Table 4

Rao-Scott Design-Adjusted Fisher's F-Tests for Headache Frequency Effects on Physical and Somatic Domains

Table 5

Rao-Scott Design-Adjusted Fisher's F-Tests for Headache Frequency Effects on Social and Academic Domains

Table 6

Rao-Scott Design-Adjusted Fisher's F-Tests for Headache Frequency Effects on Psychological Well-Being Domains

Figure Legends:

Fig.1 Methodological Flowchart of the participant Enrollment, Screening Framework and Representative Analysis Cohort (part I)

Table 1

Adolescent Screening Pool Flow and Exclusion Metrics

<i>Screening Stage</i>	<i>Sample Size (n)</i>	<i>Proportion (%)</i>
Initial Screening Pool	1,818	100.00%
Excluded (Absenteeism or Lack of Parent Consent)	439	24.15%
Final Evaluated Analytical Cohort	1,379	75.85%

Note. N = 1,818 initial candidates tracked across nine academic institutions.

Table 2

Subjective Headache Pain Severity Profiles among Active Sufferers

<i>Subjective Severity Level</i>	<i>Frequency (n)</i>	<i>Active Sample Share (%)</i>
Mild ('not bad')	381	32.99%
Moderate ('quite bad')	515	44.59%
Severe ('very bad')	72	6.23%
Missing / Unspecified	187	16.19%

Note. Total active 12-month sufferers n = 1,155.

Table 3

Cross-Tabulation of Headache Severity Profiles by Lifestyle Physical Activity Levels

<i>Clinical Severity / Frequency Profile</i>	<i>Routine Exercise n (% within profile)</i>	<i>Complete Inactivity n (% within profile)</i>
Low Frequency / Mild Pain	424 (68.49%)	112 (20.86%)
High Frequency / Severe Pain	63 (10.18%)	342 (63.69%)
Missing / Unspecified Activity	132 (21.32%)	83 (15.46%)

Note. Percentages represent proportions within each physical activity profile columns (Routine Exercise Total = 619, Inactivity Total = 537). Severe sufferers show complete exercise avoidance (63.69%) driven by fear-avoidance beliefs.

Table 4

Rao-Scott Design-Adjusted Fisher's F-Tests for Headache Frequency Effects on Physical and Somatic Domains

<i>HRQOL Physical / Somatic Domain</i>	<i>F</i>	<i>DF1</i>	<i>DF2</i>	<i>p-value</i>
Physical Energy Levels	59.10	1	8	<.001
Significant Chronic Daily Exhaustion	52.90	1	8	<.001
Significant Somatic Illness Awareness	11.55	1	8	.009
Resilient Generalized Anxiety / Fear	2.83	1	8	.425

Note. Degrees of freedom are design-corrected ($DF2 = m - 1 = 8$) to account for nesting within 9 institutional clusters. Anxiety remains highly resilient post-adjustment.

Table 5

Rao-Scott Design-Adjusted Fisher's F-Tests for Headache Frequency Effects on Social and Academic Domains

<i>HRQOL Physical / Somatic Domain</i>	<i>F</i>	<i>DF1</i>	<i>DF2</i>	<i>p-value</i>
Significant Social Loneliness	18.31	1	8	.003
Significant Peer Relationship Deficits	17.32	1	8	.003
Significant Home and Family Dynamics	13.06	1	8	.007
Significant School Functioning	12.36	1	8	.008

Note. Design-corrected F-tests reveal powerful predictive capacities over peer alienation and academic mastery attrition.

Table 6

Rao-Scott Design-Adjusted Fisher's F-Tests for Headache Frequency Effects on Psychological Well-Being Domains

<i>HRQOL Physical / Somatic Domain</i>	<i>F</i>	<i>DF1</i>	<i>DF2</i>	<i>p-value</i>
Significant Shared Laughter and Joy	18.05	1	8	.002
Significant Chronic Boredom	14.38	1	8	<.001
Significant Personal Life Satisfaction	9.13	1	8	.014
Significant Perception of Happy Childhood	6.14	1	8	.106

Note. Childhood happiness displays a strong localized buffering effect and structural resilience post-design control ($p = .106$). This is for informational purposes only. For medical advice or diagnosis, consult a professional. AI responses may include mistakes.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [MethodologicalFlowchartPartI1.pdf](#)
- [MethodologicalFlowchartPartII1.pdf](#)
- [STROBEChecklistpartI2.docx](#)
- [STROBEChecklistpartII2.docx](#)