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Coping strategies to stressful events in adolescents with migraine

Martina Proietti Checchi^{1*}, Samuela Tarantino¹, Laura Papetti¹, Fabiana Ursitti¹, Gabriele Monte¹, Giorgia Sforza¹, Alessandra Voci¹, Claudia Ruscitto¹ and Massimiliano Valeriani^{1,2,3}

Abstract

Objective Several studies examined stress factors in both adult and pediatric patients with migraine, but few of them have analyzed coping strategies adopted to deal with stressful events in pediatric age. In particular, some of these studies have focused on specific migraine populations or have not employed standardized instruments. Our study used a standardized tool to investigate the coping strategies adopted by patients with primary migraine in dealing with stressful events.

We aimed at exploring: 1) Coping responses to stressful events and their possible association with migraine characteristics such as headache frequency, pain intensity and use of prophylactic treatment; (2) Potential differences in anxiety and depression symptoms based on migraine characteristics, and (3) Association between migraine characteristics, coping strategies, and psychological aspects.

Methods We studied 81 adolescents (mean age 13.8 ± 1.6 years; 18 M and 63 F). They were divided into: (1) high frequency (weekly to daily episodes) and low frequency (≤ 4 episodes per month); (2) mild and severe pain; (3) need for prophylactic treatment or not. To evaluate patients' anxiety, depression and coping strategies we used respectively SAFA-A, SAFA-D and CRI-Y questionnaires.

Results School and socialization represent the most commonly reported stressful events among our patients with migraine. Patients with high frequency of headache tend to adopt maladaptive coping strategies in "Logical Analysis" ($p = 0.012$), "Positive Reappraisal" ($p = 0.002$) and "Total Approach" ($p < 0.001$). Moreover, patients with a high frequency of headache showed higher anxiety and depression scores ($p < 0.050$). On the other hand, lower scores in some subscales of anxiety and depression emerged in high frequency patients who used "Logical Analysis" maladaptively ($p < 0.050$).

Conclusion Adolescents with a more disabling migraine pattern tend to employ maladaptive coping strategies focused on active behavioral responses to the stressful events.

Keywords Migraine, Adolescents, Anxiety, Depression, Coping strategies, Stressful events

Introduction

Headache is a common issue in childhood and adolescence, representing the primary source of chronic pain [1]. Globally, nearly 60% of young individuals experience frequent episodes of headache, with migraine affecting approximately 7.7% to 9.1% [1, 2]. Chronic headache represents a significant challenge among children and adolescents [3, 4]. Persistent pain in children and adolescents

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can be unsettling and threatening, often resulting in school absenteeism, difficulty in maintaining social activities, and ultimately leading to a low quality of life [5, 6]. To alleviate the frequency and intensity of pain, migraine prophylaxis is used. In pediatric age, the real efficacy of prophylactic drugs is difficult to be evaluated, due to the power of the placebo effect [7]. Primary headache in children is commonly understood to arise from a multifaceted interplay of bio-psycho-social factors [8]. The relationship between migraine and psychological symptoms has been extensively researched. Environmental factors could cause psychological symptoms that might be involved in the onset and maintenance headaches. Although the precise connection between psychological factors and headache remains incompletely elucidated the relationship between migraine and psychological conditions like anxiety and depression is likely to be bidirectional [9, 10]. The presence of common neurobiological mechanisms among mood disorders, anxiety, and headaches, such as hypoactivity of the serotonergic system and/or imbalances in dopamine levels, may explain the association between headaches and psychological disorders [11]. Viewed from a neurobiological perspective, both migraine and several psychiatric disorders share similar anatomical and functional networks, such as the frontostriatal circuits, which contribute to the co-occurrence of migraine and psychological disturbances [12]. Stress can play a fundamental role in the lives of migraine patients and in pain management. The presence of psychological stress, caused by adverse childhood experiences (such as bereavement, family stress, parental divorce, physical and emotional abuse) [13, 14], may contribute to the onset, exacerbation, and persistence of migraine even in the absence of psychological disorders [15, 16]. In stress management, dysfunctional strategies may amplify stress and complicate pain management, whereas more functional approaches could lead to a reduction in stress and exert a protective effect on migraine. For example, an adolescent who experiences school as a source of stress may face a particularly difficult assignment. Whether a dysfunctional problem-solving strategy is adopted, behaviors and thoughts that fuel anxiety and a sense of despair and potentially work as triggering factor for serving as a triggering factor for headache. Additionally, we must consider that the presence headache may be activated. Additionally, we must consider that the presence of headache may influence how individuals face everyday challenges perceived as stressful. Coping strategies can be addressed through cognitive-behavioral therapy (CBT), which helps not only to improve the response to stress but also to have a positive impact on pain and emotional aspects [17].

Several studies have examined stress factors in both adult and pediatric patients with migraine, but few of them have analyzed in detail the coping strategies adopted to deal with stressful events in pediatric age. In particular, some of these studies have focused on specific migraine populations (chronic headache and psychiatric comorbidity) or have not employed standardized instruments.

Coping has been defined as an individual's effort to employ cognitive and behavioral tactics to manage and control pressures, demands, and emotions when faced with stress [18]. Historically, different classifications of coping styles have been proposed, such as between internal and external strategies, active and passive coping, and problem-focused and emotion-focused coping. These classifications are based on different theoretical frameworks. Folkman and Lazarus conceptualize two broad categories of coping: problem-focused coping (involving active behavior) and emotion-focused coping (involving passive approaches). Problem-focused coping involves efforts to reduce or alleviate these demands, thereby altering the source of stress. On the other hand, emotion-focused coping aims to reduce emotional responses linked to stress and includes tactics like seeking social support, withdrawal, or social isolation [19]. Spielberger, building on the classification of Folkman and Lazarus, created a more detailed classification. He introduced the distinction between active coping and passive coping as an addition to the existing distinction between problem-focused coping and emotion-focused coping. Some studies conducted on adults have suggested that individuals with migraine tend to adopt dysfunctional coping strategies in handling difficulties, especially those that are more introspective, such as avoidance and concealment [20, 21]. Compared to healthy individuals, these people seek social support less frequently and tend to respond passively to problems [22]. These patterns suggest a tendency among migraine sufferers to adopt a more reserved stance when seeking emotional support from others. In young childhood, contrasting results emerge. In a study by Mara Frare et al. [23] of children with migraine, headache characteristics were not associated with coping mechanisms. In contrast, a study of adolescents with migraine and mental health problems found that patients with chronic migraine, particularly those with comorbid mental health problems, tend to predominantly use dysfunctional internal coping strategies rather than seeking external support [24]. This last study is in line with studies conducted in adulthood and supports the idea that migraine patients tend to predominantly and dysfunctionally use problem-focused coping strategies and internalizing types of coping.

In light of these results, we analyzed more in detail, using a standardized tool, the coping mechanisms employed to manage stressful situations in adolescents with migraine. We hypothesized that: 1) adolescent migraine patients use dysfunctional coping strategies when facing stressful events; 2) patients with severe migraine are more likely to adopt dysfunctional coping strategies, particularly in actively problem-focused strategies; 3) patients who dysfunctionally use actively problem-focused coping strategies have higher anxiety scores.

Our study used a standardized tool to investigate the coping strategies adopted by patients with primary migraine in dealing with stressful events. Specifically, we investigated: (1) the association between coping strategies and migraine characteristics (such as frequency, intensity, and use of a prophylactic treatment), (2) the differences in anxiety and depression symptoms based depending on migraine characteristics, and (3) the association between migraine characteristics, coping strategies, and psychological aspects.

Material and methods

Selection and classification of the patients

Patients were identified through a systematic review of clinical records of adolescents referred to Headache Center of the Bambino Gesù Children's Hospital in Rome from September 2018 to September 2022. Data concerning the clinical characteristics of the headache, administered therapies, and discharge diagnoses were collected using a headache diary given at the initial consultation and brought back by the family during the subsequent visit. A comprehensive neurological examination was conducted for each patient. Only patients with a diagnosis of migraine, with or without aura, according to ICHD-3 criteria [25] were included. Cases involving tension-type headaches, trigeminal autonomic cephalalgias, secondary headaches, or patients afflicted by any other neurological conditions were intentionally excluded from our study. According to the frequency, patients were classified into two groups: 1) high frequency (HF; participants complaining of more than 4 attacks per month); 2) low frequency (LF; children/adolescents with ≤ 4 episodes per month). The break point was mainly chosen for separating patient who needed preventive pharmacological treatment from those who did not. Only five youth in the current study met criteria for chronic migraine; as such we combined youth with higher frequency episodic migraine and chronic migraine in our HF group.

In addition, the average number of migraine episodes in the previous two months was assessed. Pain intensity was classified into severe (SI) or mild (MI) based on interference with daily activities. Patients were divided into those who had received prophylactic treatment (including also

patients with treatment terminated before 4 weeks) and those who were not. We included only patients who had previously completed evaluations for coping mechanisms, anxiety levels, and depressive symptoms. The psychological assessment was carried out by psychologists (MPC and ST) with a specialized training in pediatric psychological well-being.

The Institutional Review Board of Bambino Gesù Children's Hospital provided approval for this study. Written informed consent for patient information to be published was provided by the parents of subjects involved in the research.

Instruments and measures

Frequency and Intensity of migraine attacks

Headache frequency and intensity were measured on the base of patients' headache diary. The frequency of headache attacks was calculated by considering the last two months. Concerning pain intensity, patients were asked to record in the diary how much the migraine attacks impacted their daily activities. Particularly, they were asked to write whether the pain was so severe that it forced them to stop their activities or so mild that it allowed them to continue.

Anxiety and depressive symptoms

The Italian Self Administered Psychiatric Scales for Children and Adolescents battery of tests was the assessment tool used in our study [26]. This battery of tests comprises six scales that can be utilized either collectively or individually, with each scale further divided into multiple subscales. The SAFA assessment covers a wide array of psychiatric symptoms and psychological conditions, encompassing anxiety-related domains (SAFA-A), depression-related domains (SAFA-D), somatic concerns (SAFA-S), obsessive-compulsive symptoms (SAFA-O), psychogenic eating disorders (SAFA-P), and phobias (SAFA-F). The assessment process generates an individual profile, which includes one of the aforementioned scales along with its corresponding subscales, as well as an overall global profile. The complete battery of tests can typically be completed within a timeframe of 30 to 60 min. Regarding age groups, the questionnaire was structured into two versions: "e" for patients aged 8–10 years, and "m/s" for those aged 11–18 years. For each item, the subject has three possible answers: "true (scoring 2), partly true (scoring 1), and false (scoring 0)." The cumulative points achieved in each scale and subscale can be converted into T scores, sten points and percentiles. SAFA-A includes four subscales that contribute to a "Total anxiety" score: "Generalized anxiety," "Social anxiety," "Separation anxiety" and "Scholastic anxiety". The questionnaire consists of 42 items for the "e" version

and 50 items for the "m/s". Furthermore, SAFA-D also yields a comprehensive score and encompasses seven distinct subscales: "Depressed mood", "Anhedony", "Irritable mood", "Sense of inadequacy", "Insecurity", "Feeling of guilt" and "Hopelessness". This scale comprises 48 items for the "e" version and 56 items for the "m/s" version. Within these scales, there are "items of lies," six for SAFA-D "e," and the same six plus one for SAFA-D "m-s," in order to verify the reliability of the answers [26]. The SAFA battery underwent validation and demonstrated robust psychometric properties [26–28]. In our study, the Cronbach's alpha values were calculated to assess internal consistency, resulting in α values of 0.84 responses to SAFA anxiety questions and 0.77 for SAFA depression. Additionally, when considering SAFA Anxiety and Depression collectively, the α value indicated strong reliability ($\alpha=0.81$). T scores distinguish between full-blown pathological scores ($T>69$, which is above the 95th percentile) and those displaying profiles with marginally pathological scores (T scores: 60–69, specifically, in the 85th–95th percentile). In our case, we have grouped the scores as follows: within the "normal range" ($T<59$) and "not normal range" ($T>60$).

Coping strategies in stressful life events

The coping strategies adopted to deal with stressful events were assessed using the Coping Responses Inventory-Youth (CRI-Y). We selected the CRI-Y because it allows for a detailed evaluation of coping strategies in response to specific and recent stressful events, which in our opinion could provide a reliable information about the typical coping approach of the subject.

The CRI-Y is a psychological assessment tool designed to measure the coping strategies that adolescents between the ages of 12 and 18 use to manage stress and challenging situations in their lives [29]. The CRI-Y was specifically developed to assess coping responses among individuals aged 12 to 18 years. The CRI-Y provides

space to describe a problem or stressful situation that occurred in the last year. Following this, there are 48 items to which the patient responds, keeping in mind the event they have described above. The patient responses range from 0 ('no, never') to 3 ('yes, almost always'). The questionnaire assesses eight coping strategies (six items for factor; minimum score=0; maximum score=18) that can be divided into four "approach scales" and four "avoidance scales". The "approach scales" are: 1) Logical analysis: Consists of trying to understand and mentally prepare to cope with stress and what might happen because of it; 2) Positive Reappraisal: cognitive attempts to construct and restructure a problem in a positive way while accepting the reality of the situation; 3) Seeking guidance and support: efforts to seek information, support, and guidance through behavior; 4) Problem Solving: Actions aimed at directly addressing the problem through proactive measures. The "avoidance scales" are: 1) Cognitive avoidance: cognitive efforts to evade realistic thinking about the problem; 2) Acceptance or resignation: cognitive attempts to respond to the problem by accepting it; 3) Seeking alternative rewards: efforts to change one's behavior in order to participate in different activities and create new sources of satisfaction; 4) Emotional discharge: behavioral attempts to alleviate stress through the expression of negative emotions. Within each category, there is a further division into "cognitive strategies" and "behavioral strategies". Figure 1 provides a summary of the response categories in connection with the eight factors of the CRI-Youth. T scores are categorized as follows: "Considerably below" ($T<34$), "Markedly below" ($T=35-40$), "Just below" ($T=41-45$), "Average" ($T=46-54$), "Just above" ($T=55-59$), "Markedly above" ($T=60-65$), "Considerably above" ($T\geq 66$). Scores "Considerably below", "Markedly below", "Markedly above" and "Considerably above" the normal range were considered "maladaptive coping strategies".

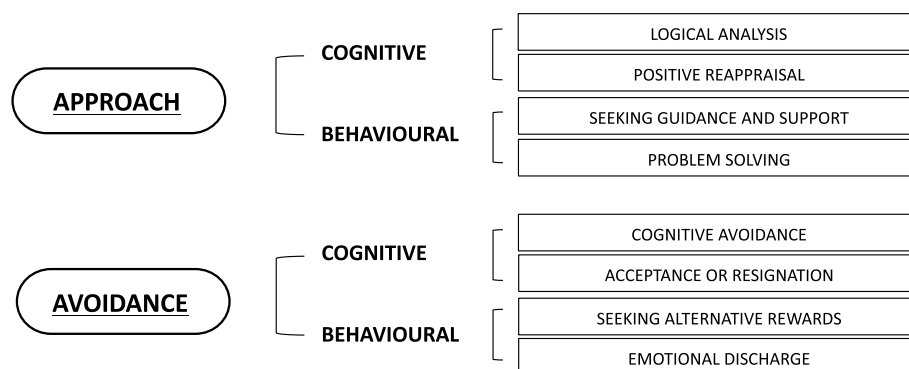


Fig. 1 Classification and subdivision of coping strategies

Statistical analysis

The statistical analysis of data was conducted using the software Jamovi and Software R (R Foundation for Statistical Computing). Initially, descriptive statistical methods were employed to analyze headache trends, such as the frequency of episodes, pain intensity, and the use of prophylactic treatment. Percentages, the means and standard deviations of the different variables analyzed were calculated. The t-test and Mann–Whitney U test (non-parametric method) was employed to detect distinctions between continuous variables. The ANOVA and Kruskal–Wallis test (non-parametric method) was utilized to compare the SAFA scores among patients with low and high attack frequency, as well as varying levels of pain intensity and the presence or absence of prophylactic treatment. The relationship between the categorical variables was assessed using the chi-square test. The established level of statistical significance for all conducted tests was set at $p < 0.05$. When multiple comparisons were performed, we adjusted the p-value using Bonferroni correction. To keep the family error rate at < 0.05 , the alpha level was set—based on the different number of comparisons—at 0.016 (for migraine characteristics and coping strategies), 0.008 (for migraine characteristics and anxiety/depression), 0.005 (for relevant coping strategies and anxiety/depression) for each comparison.

Results

We studied 81 White adolescents with migraine with and without aura (mean age 13.8 ± 1.61 years; 18 M and 63 F).

Migraine features

Concerning the frequency of migraine attacks, 38.3% of patients could be considered as HF, while 61.7% were included in LF group. HF patients reported a monthly average of 8.2 attacks, based on the episodes from the last two months, while LF patients had a mean of 2.3 attacks. Regarding the intensity of pain, 56.8% of patients were in the SI group, while 43.2% showed MI attacks. Of the total sample, 58.0% were receiving PT. Regarding demographic information, no differences emerged between the high and low frequency groups.

Psychological findings

Coping strategies in stressful life events

The stressful events described by the patients were grouped based on the reported themes into different categories: grief, socialization, school, health, and family. Of the total sample, 33.3% reported stressful events related to school, 19.8% related to socialization, 17.3% related to grief, 14.8% related to health, and another 14.8%

related to family (Table 1). Analyzing the entire sample, we observed a generally normal utilization of coping strategies. However, when dividing patients on the base of migraine characteristics, different patterns of coping strategies emerged.

– Frequency of headache

HF patients adopted maladaptive coping strategies more frequently than LF patients in “Logical Analysis” ($p = 0.012$), “Positive Reappraisal” ($p = 0.002$), and “Total Approach” ($p < 0.001$) (Table 2).

– Intensity of pain

SI patients adopted maladaptive coping strategies more frequently than those MI patients in “Problem Solving” ($p = 0.027$). Although the p-value is significant, considering the Bonferroni correction, it cannot be considered statistically significant in a rigorous manner, as it may predict a Type I error.

– Prophylactic treatment

Regarding the use of prophylactic treatment, our data showed that patients not undergoing prophylactic treatment exhibited a dysfunctional use of the “Seeking Alternative Rewards” strategy ($p = 0.050$). Although the p-value is significant, considering the Bonferroni correction, it cannot be considered statistically significant in a rigorous manner, as it may predict a Type I error.

Anxiety

Of the overall sample, 51.9% exhibited high scores for anxiety symptoms. HF patients exhibited higher “Generalized Anxiety” scores compared to LF patients” ($p = 0.009$; mean HF = 15.29 SD = 6.12, mean LF = 11.50 SD = 6.19). They also exhibited higher scores in “Total Anxiety” (SAFA-A Total, $p = 0.032$), “Social Anxiety” ($p = 0.044$; mean HF = 11.58 SD = 6.16, mean LF = 8.92 SD = 5.36) and “Scholastic Anxiety” ($p = 0.047$; mean HF = 13.39 SD = 6.46, mean LF = 10.72 SD = 5.32). However, these data should be interpreted with caution, as they may predict a Type I error (Table 3). No significant differences were found depending on both pain intensity and use of prophylaxis.

Depression

Forty-two percent of our patients reported high depressive scores. HF patients showed higher scores compared to LF patients in “Sense of Inadequacy” ($p = 0.011$; mean HF = 6.81 SD = 4.31, mean LF = 4.42 SD = 3.85) and “Hopelessness” subscales ($p = 0.013$; mean HF = 5.03

Table 1 Distribution of patients based on the described stressful event and the coping strategies adopted

APPROACH SCALES															
Stressful events	Logical Analysis			Positive Reappraisal			Seeking guidance and support			Problem Solving			Total Approach		
	norm	dysfunctional	norm	dysfunctional	norm	dysfunctional	norm	dysfunctional	norm	dysfunctional	norm	dysfunctional	norm	dysfunctional	
School	15	12	16	11	18	9	17	33.3%	63.0%	10	17	37.0%	63.0%	10	
	55.6%	44.4%	59.3%	40.7%	66.7%	33.3%	63.0%							37.0%	
Socialization	10	6	11	5	9	7	11	43.8%	68.8%	5	14	31.3%	87.5%	2	
	62.5%	37.5%	68.8%	31.3%	56.3%	43.8%	68.8%							12.5%	
Grief	8	6	9	5	5	9	7	64.3%	50.0%	7	9	50.0%	64.3%	5	
	57.1%	42.9%	64.3%	35.7%	35.7%	64.3%	50.0%							35.7%	
Health	7	5	9	3	7	5	7	41.7%	58.3%	5	11	41.7%	91.7%	1	
	58.3%	41.7%	75.0%	25.0%	58.3%	41.7%	58.3%							8.3%	
Family	8	4	6	6	9	3	7	25.0%	58.3%	5	9	41.7%	75.0%	3	
	66.7%	33.3%	50.0%	50.0%	75.0%	25.0%	58.3%							25.0%	
AVOIDANCE SCALES															
Stressful events	Logical Analysis			Positive Reappraisal			Seeking guidance and support			Problem Solving			Total Approach		
	norm	dysfunctional	norm	dysfunctional	norm	dysfunctional	norm	dysfunctional	norm	dysfunctional	norm	dysfunctional	norm	dysfunctional	
School	20	7	19	8	16	11	19	40.7%	70.4%	8	24	29.6%	88.9%	3	
	74.1%	25.9%	70.4%	29.6%	59.3%	40.7%	70.4%							11.1%	
Socialization	12	4	11	6	10	6	10	62.5%	62.5%	6	14	37.5%	87.5%	2	
	75.0%	25.0%	68.8%	37.5%	62.5%	37.5%	62.5%							12.5%	
Grief	7	7	9	6	6	8	11	57.1%	78.6%	3	11	21.4%	78.6%	3	
	50.0%	50.0%	64.3%	42.9%	42.9%	57.1%	78.6%							21.4%	
Health	10	2	9	5	6	6	10	50.0%	83.3%	2	11	16.7%	91.7%	1	
	83.3%	16.7%	75.0%	41.7%	50.0%	50.0%	83.3%							8.3%	
Family	8	4	6	6	8	3	9	25.0%	75.0%	3	11	25.0%	91.7%	1	
	66.7%	33.3%	50.0%	50.0%	66.7%	25.0%	75.0%							8.3%	

Table 2 Distribution of coping strategies among patients based on migraine characteristics

	Frequency of headache						Intensity of pain						Prophylactic treatment					
	High Frequency			Low Frequency			Severe Pain			Mild Pain			Receiving Treatment			Not Receiving Treatment		
	norm	dysfunctional	p-values	norm	dysfunctional	p-values	norm	dysfunctional	p-values	norm	dysfunctional	p-values	norm	dysfunctional	p-values	norm	dysfunctional	p-values
COPING CRI-Y	N	N		N	N		N	N		N	N		N	N		N	N	
	%	%		%	%		%	%		%	%		%	%		%	%	
Logical Analysis	13	18	0.012	35	15		30	16		18	17		28	19		20	14	
	41.9%	58.1%		70.0%	30.0%		65.2%	34.8%		51.4%	48.6%		59.6%	40.4%		58.8%	41.2%	
Positive Reappraisal	13	30	0.002	38	12		30	16		21	14		29	18		22	12	
	63.0%	37.0%		76.0%	24.0%		65.2%	34.8%		60.0%	40.0%		61.7%	38.3%		64.7%	35.3%	
Seeking guidance and support	19	12	0.770	29	21		29	17		19	16		28	19		20	14	
	61.3%	38.7%		58.0%	42.0%		63.0%	37.0%		54.3%	45.7%		59.6%	40.4%		58.8%	41.2%	
Problem Solving	15	16	0.079	34	16		23	23		26	9		30	17		19	15	
	48.4%	51.6%		68.0%	32.0%		50.0%	50.0%		74.3%	25.7%		63.8%	36.2%		55.9%	44.1%	
Total Approach	16	15	<.001	44	6		34	11		26	10		37	10		23	11	
	51.6%	48.4%		88.0%	12.0%		75.6%	24.4%		72.2%	27.8%		78.7%	21.3%		67.6%	32.4%	
Cognitive Avoidance	21	10	0.683	36	14		36	9		21	15		34	13		23	11	
	67.7%	32.3%		72.0%	28.0%		80.0%	20.0%		58.3%	41.7%		72.3%	27.7%		67.6%	32.4%	
Acceptance or Resignation	17	14	0.315	33	17		24	21		26	10		30	17		20	14	
	54.8%	45.2%		66.0%	34.0%		53.3%	46.7%		72.2%	27.8%		63.8%	36.2%		58.8%	41.2%	
Seeking alternative rewards	18	13	0.855	28	22		26	19		20	16		31	16		15	19	
	58.1%	41.9%		56.0%	44.0%		57.8%	42.2%		55.6%	44.4%		66.0%	34.0%		44.1%	55.9%	
Emotional Discharge	21	10	0.417	38	12		33	12		26	10		33	14		26	8	
	67.7%	32.3%		76.0%	24.0%		73.3%	26.7%		72.2%	27.8%		70.2%	29.8%		76.5%	23.5%	
Total Avoidance	25	6	0.131	46	4		38	7		33	3		42	5		29	5	
	80.6%	19.4%		92.0%	8.0%		84.4%	15.6%		91.7%	8.3%		89.4%	10.6%		85.3%	14.7%	

P-value adjusted after Bonferroni correction at 0.016

Table 3 Anxiety and depression symptoms in patients with high and low frequency of attacks

	High Frequency	Low Frequency	χ^2	ϵ^2	<i>p</i>
SAFA scales	Mean (SD)	Mean (SD)			
SAFA-A generalized anxiety	15.29 (6.12)	11.50 (6.19)	7018	0.0877	0.009
SAFA-A social anxiety	11.58 (6.16)	8.92 (5.36)	4682	0.0585	0.044
SAFA-A separation anxiety	5.97 (6.00)	7.16 (4.42)	1172	0.0147	0.195
SAFA-A scholastic anxiety	13.39 (6.46)	10.72 (5.32)	3942	0.0493	0.047
SAFA-A total anxiety	52.19 (40.11)	38.30 (16.44)	4656	0.0582	0.032
SAFA-D depressed mood	6.58 (4.70)	4.72 (4.20)	3223	0.0403	0.068
SAFA-D anhedonia	3.35 (3.34)	2.40 (2.20)	0.984	0.0123	0.324
SAFA-D Irritable mood	8.16 (4.66)	6.66 (3.73)	2347	0.0293	0.114
SAFA-D sense of inadequacy	6.81 (4.31)	4.42 (3.85)	5768	0.0721	0.011
SAFA-D insecurity	10.16 (4.01)	8.32 (3.49)	5865	0.0733	0.032
SAFA-D feeling of guilt	4.39 (2.82)	3.24 (2.87)	3963	0.0495	0.082
SAFA-D hopelessness	5.03 (3.80)	2.92 (3.03)	6172	0.0772	0.013
SAFA-D total depression	55.81 (64.75)	34.00 (16.80)	6313	0.0789	0.026

P-value adjusted after Bonferroni correction at 0.008

SD=3.80, mean LF=2.92 SD=3.03). They also exhibited higher scores in "Total Depression" ($p=0.026$; mean HF=55.81 SD=64.65, mean LF=34.00 SD=16.80) and "Insecurity" ($p=0.032$; mean HF=10.16 SD=4.01, mean LF=8.32 SD=3.49). However, these data should be interpreted with caution, as they may predict a Type I error (Table 3). No significant differences were found depending on both pain intensity and use of prophylaxis.

The association between Migraine Features, Coping Strategies in Stressful Life Events, and Psychological Findings

– Frequency of headache

We found an association between migraine frequency, psychological findings and a maladaptive use of "Logical Analysis". In particular, HF patients with maladaptive "Logical Analysis" showed significantly lower scores in "Social Anxiety" ($p=0.004$). In addition, they showed lower scores in "School Anxiety" ($p=0.013$) and "Irritable Mood" (0.008) (Table 4) which considering Bonferroni's correction, cannot be considered statistically significant in a rigorous way, as it might prelude a Type I error.

– Intensity of Pain

SI patients with maladaptive "Positive Reappraisal" showed significantly higher scores in "Scholastic Anxiety" ($p=0.003$) and "Insecurity" (0.004).

– Prophylactic treatment

Patients undergoing prophylactic treatment with maladaptive "Positive Reappraisal" showed higher scores in "Total Anxiety" ($p=0.046$) and "Separation Anxiety" ($p=0.018$). Although the *p*-value is significant, considering the Bonferroni correction, it cannot be considered statistically significant in a rigorous manner, as it may predict a Type I error.

Discussion

This is the first study to investigate in detail coping strategies in managing stressful events among pediatric patients diagnosed with migraine, using a standardized instrument.

The main findings of our study are as follows: (1) overall, patients with migraine use normal coping strategies to deal with stressful events; (2) school and socialization are the most common stressful events reported by adolescents diagnosed with migraine; (3) Individuals experiencing more disabling headache patterns use dysfunctional coping strategies based on actively managing the stressful event ("Logical Analysis" and "Positive Reappraisal"); (4) There is an association between migraine patterns, particular coping strategies, and emotional aspects.

Migraine features and Coping strategies in stressful life events

Overall, our sample showed a normal use of coping strategies to deal with stressful events.

The most stressful events reported by our patients mainly revolved around school and socialization. These findings support previous scientific literature. Several studies have focused on the role of psychological and

Table 4 Summary profile of patients according to migraine characteristics and possible hypotheses

	FREQUENCY OF HEADACHE	INTENSITY OF PAIN	PROPHYLACTIC TREATMENT
CHARACTERISTIC	HIGH FREQUENCY COMPARED WITH LOW FREQUENCY	SEVERE INTENNSITY COM- PARED WITH MILD INTENSITY	NOT RECEIVING TREATMENT COMPARED WITH RECEIVING TREATMENT
MALADAPTIVE COPING	<ul style="list-style-type: none">• Logical Analysis lower scores in:—Social Anxiety- Scholastic Anxiety- Irritable mood- Sense of Inadequacy• Positive Reappraisal• Total Approach	<ul style="list-style-type: none">• Problem Solving	<ul style="list-style-type: none">• Seeking Alternative Rewards
HIGHER ANXIETY SCORES	<ul style="list-style-type: none">• Social Anxiety• Scholastic Anxiety	No significant differences	No significant differences
HIGHER DEPRESSION SCORES	<ul style="list-style-type: none">• Sense of Inadequacy• Insecurity• Hopelessness	No significant differences	No significant differences
CONCLUSIONS AND HYPOTHESES	<p>⇒ Tend to adopt highly rational or analytical approaches, often neglecting emotional awareness</p> <p>⇒ Overall higher levels of anxiety and depression</p> <p>⇒ Those who exhibit dysfunctional use of “Logical Analysis” report lower levels on rational control over their emotions</p>	<p>⇒ Difficulty in finding effective solutions, which can negatively impact their ability to manage both pain and other stressful aspects of life</p>	<p>⇒ Tend to seek immediate gratification to cope with stress rather than addressing problems directly</p>

social issues as potential risk factors for headache [30]. Stressors in the school environment, such as academic pressure, fear of failure, and social difficulties, have been found to be associated with higher levels of headache [8, 31–33]. In a study by Gini et al., a positive association between migraine and problems in social relationships, such as being bullied, was described [34]. In addition, seasonal variation in headache has been demonstrated, with exacerbation during the school months and improvement during summer holidays, suggesting that school activities may represent an important trigger of headache [35, 36].

Although our patients showed a normal response to stressful events, the division based on the severity of migraine revealed the use of dysfunctional coping strategies.

The present results shed light on the complex relationship between migraine and coping strategies.

Confirming our hypothesis, patients with severe migraine exhibited dysfunctional responses in problem-focused coping strategies in an active manner. In our study, HF patients showed a tendency to adopt highly rational or analytical approaches in a dysfunctional manner when managing stress, neglecting emotions, and awareness of them.

We can hypothesize that of patients with high frequency migraine attacks may experience cognitive overload for managing their own migraine. Consequently, whether faced with additional sources of stress, they may lack the necessary cognitive resources. This perception

could lead them to view the situation as more complex and stressful. We could also hypothesize that these patients have lower levels of resilience or dysfunctional adaptive capacities, which could generate greater stress when managing problems. This increased stress, in turn, may trigger migraine episodes [16, 37–40]. SI patients showed difficulty in finding a functional problem resolution. The hypothesis can be made that individuals with severe pain intensity may have difficulty in finding effective solutions, which can negatively impact their ability to manage both pain and other stressful aspects of life.

Most youth in our sample suffered from episodic migraine, which may be a potential limitation to the generalizability of the study to populations of young people with HF.

The association between Migraine Features, Coping Strategies in Stressful Life Events, and Psychological Findings

Among our patients, those suffering from a HF of attacks had a higher total anxiety and depression compared to those with LF. In particular, the anxiety and depression scores were higher in some SAFA-A and D subscales, indicating that HF patients may experience more anxious feelings in various aspects of life (such as social relationships and school), and increased sense of inadequacy and despair.

Our data have revealed associations between migraine characteristics, coping strategies, and psychological

outcomes. Contrary to our hypothesis, according to which patients who dysfunctionally used actively problem-focused coping strategies were expected to have higher anxiety scores, the results show that a dysfunctional use of these strategies in patients with high-frequency migraine is actually correlated with lower anxiety scores. HF patients who exhibited dysfunctional "Logical Analysis" reported lower scores in social anxiety, school-related anxiety and irritable mood. This suggests that they may show lower levels of anxiety and irritable mood due to increased rational control over their emotions and behavioral experiences. Alternatively, they might primarily focus on the rational dimension of situations, ignoring or minimizing emotional aspects.

This result could be explained by considering the way in which dysfunctional coping is measured in this study, where we have taken into account the inclusion of extreme responses in both directions (both excessive and deficient). The fact that a "dysfunctional" use of "Logical Analysis" can be associated with lower levels of anxiety suggests that, for patients with HF, having greater rational control over their emotions and behavioral responses may actually provide a mental health benefit. In other words, high mental preparation for stressful events could represent an adaptive form of coping, albeit dysfunctional, that allows patients to reduce their anxiety and irritability. As for pain intensity, SI patients with dysfunctional "Positive Reappraisal" showed higher levels of social anxiety, school-related anxiety and insecurity.

Conclusion

Our study showed how the management of stressful events can be influenced by the severity of migraine. In the case of frequent migraines, patients tend to respond more dysfunctionally to life's stressful events. More specifically, they tend to adopt dysfunctional coping strategies based on actively managing the stressful event. Surprisingly, patients with dysfunctional logical reasoning presented lower anxiety scores. This trend may lead us to reflect on the fact that, in patients with frequent migraine, it could represent a benefit for mental health. We are aware that the picture painted by our results is extremely complex. However, it underlines that the management of pediatric migraine patients cannot be based only on one dimension, e.g. pharmacological, but it requires a holistic approach in which psychological and behavioral treatments, aimed at working on coping strategies, should be considered essential. We believe it would be useful, in future studies, to use more standardized methods to assess pain severity, such as the pain intensity scale, in order to allow for a more precise understanding. In addition, it is necessary to enlarge the sample to confirm the results to the limit of significance.

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Authors' contributions

Conceptualization, M.P.C. and S.T.; methodology, M.P.C. and L.P.; software, M.P.C.; validation, L.P.; data curation, F.U., G.M.; writing—original draft preparation, M.P.C.; writing—review and editing, S.T. and L.P.; supervision, M.V. All authors have read and agreed to the published version of the manuscript.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

The study was approved by the Ethical Committee of Bambino Gesù Children's Hospital.

Consent for publication

Informed consent was obtained from all subjects involved in the study.

Competing interests

The authors declare no competing interests.

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