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HEADACHE AND ITS CORRELATIONS WITH OBESITY AND CARDIOVASCULAR RISK FACTORS IN ELEMENTARY SCHOOL CHILDREN

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ABSTRACT

Headache is a disabling condition causing individual impaired quality of life in adults and in children. Positive correlation between obesity and primary pediatric headaches is mostly true for migraine. Also eating habits, influence headaches. There is paucity of information on cardiovascular risk factors for headache in children, although a relationship between migraine and cardiovascular diseases has been reported in adulthood.

238 children (127 females) aged 6 to 10 years from primary schools were included in the study. A questionnaire on life habits, Body Mass Index (BMI), PedMIDAS score, pain scale intensity score and cardiovascular investigation were performed in all. The two-step cluster analysis identified three groups of children based on PedMIDAS scores: first group "absent pain", the second "sporadic, low-impact, mild pain", the third as "non sporadic, moderate-impact, severe pain". Only sex, BMI, gestational hypertension, and fish eating could discriminate among the three headache clusters.

Our study suggest that adopting a healthy lifestyle before 10 years of age could be a good way to prevent a highly probable headache worsening at later ages.

KEYWORDS : headache, obesity, cardiovascular risk

Introduction:

Headache is a global disabling condition causing considerable individual suffering and impaired quality of life in adults as well as in children.1 It causes a substantial impact on physical and mental health and, in children, also affects school performance.2,3 MIDAS (MIgraine Disability ASsessment) for adults and PedMIDAS for children showed to be highly effective tools to assess headache disability and the subsequent treatments and outcomes.4 The estimated overall prevalence of headache in European children under 10 years of age ranges from 21% to 56%, while migraine prevalence is about 2.7-3.7%.[1]

Gender risk for headache in pediatric age is not fully known. Although males are more frequently affected in childhood and females after puberty,5 the majority of the studies reported that headaches are more prevalent in girls than in boys in both primary and high-school students.6 In any case, a worsening of headache is highly probable after the twelfth year of age.[1]

Various papers reported a positive correlation between obesity and pediatric headaches.[7,8,9,10,11] Moreover, primary headaches occur more frequently in overweight children than in normal-weight ones; that is mostly true for migraine.[10] Also eating habits, i.e. quality of food or fasting, influence headaches.[11]

There is paucity of information on cardiovascular risk factors for headache in pediatric age. As in adults, the right-to-left shunt (RLS) prevalence was significantly greater in subjects with aura;[12,13] children with migraine were found to have higher levels of LDL and lower levels of HDL by Glueck,[14] but not by Poyrazoglu;[15] higher carotid intima-media thickness values were observed in the latter study in migraine children respect to healthy controls.

Treatment of pediatric headache is complex since available pharmacological options are poorly effective if not unsuitable in this population of patients. A recent study found neither of two preventive medications, i.e. amytriptiline and topiramate, for pediatric migraine was more effective than placebo in reducing the number of headache days over a period of 24 weeks. Moreover, patients who received the two drugs had higher rates of adverse events than those who received placebo.[16] Consequently, it is highly desirable to know the risk profile for pediatric headache in order to perform preventive health-related interventions.

Our study aimed at finding the main factors linked to pediatric headache, paying particular attention to weight and cardiovascular parameters in a population of school-aged children.

Methods

Two hundred and thirty eight children (127 females and 111 males) aged 6 to 10 years from primary schools of Telese Terme/Puglianello, Italy, representing 78% of the invited subjects, were included in the present study.

- Parents were asked to answer to a detailed questionnaire including:
- Parents and child baseline characteristics
- Pregnancy and birth data
- Familial vascular risk factors
- Physical activity
- TV watching and videogames playing
- Eating habits

The questionnaire included a variety of other items of potential interest, like inactivity and eating habits, to characterize the girls/boys at risk for headache. Child weight and height, waist circumference, and forearm circumference were also obtained. The body mass index (BMI) was calculated by both kg/m2 and percentile.

A translated version of the questionnaire is available as supplementary material (see appendix).

Presence of headache, its frequency (number of attacks per month in the last 3 months), and disability (i.e. headache impact on daily living) were evaluated by PedMIDAS questionnaire.[4]

Pain intensity was measured by the face pain scale-revised.[17]

A detailed cardiovascular investigation, including EKG and echocardiography, was performed and various parameters from the two examinations were considered in the analysis. Indeed, we hypothesized that, as in adulthood, a greater age-related ventricular mass or volume might be the clue to hypertension related headache.[18]

Statistical analysis

According to the objective of the study, i.e. finding the main factors linked to pediatric headache, data analysis aimed to identify the relationship among headache (as dependent variable) and the items of the questionnaire (as independent variables). Before applying the appropriate regression model, a first statistical analysis aimed to summarize the three headache dimensions (frequency, disability and pain) in a unique variable, in order to reduce multiple testing and consequently the risk of false positive findings. Such analysis tried to identify clusters of children with low within-clusters variability and large between-clusters variability. After log-transformation of data to obtain a better fit to Gaussian distribution, two-step cluster analysis was applied and the percentage of global variance accounted for by the resulting classification was measured by means of Hotelling's trace.

Concerning the independent variables, for each section (Parents and child baseline characteristics, Pregnancy and birth data, Familial vascular risk factors, Physical activity, TV watching and videogames playing, Eating habits, EKG and echocardiography) clinicians indicated all the potential predictors, resulting in about 50 variables.

Since three clusters were identified, the dependent variable was categorical multinomial, thus a multinomial logistic regression was applied. Firstly each of the potentially relevant variables was entered as continuous or categorical covariate. The covariates which resulted significantly associated with the dependent variable were entered in a multi-variable model in order to identify the minimal subset able to discriminate among the three clusters. Stepwise method was chosen as selection procedure. Each excluded variable was entered again to test whether their effect turned to be significant after taking into account the effect of the minimal subset. However, each variable remained non significant as in the univariate analysis.

Results

The two-step cluster analysis identified three groups of children on the basis of their PedMIDAS scores (Fig. 1) (Insert here fig 1). Such classification accounted for 79% of total variance (eta-squared based on Hotelling's trace) and, in details, 59% of headache frequency, 40% of PedMIDAS total score and 81% of headache pain. The first group [102 children (42.8%), 44 F, 58 M; F:M=0.76] was characterized by the absence of headache and consequently by scores of zero on both PedMIDAS total score and headache pain. The second group [98 children (41.2%), 60 F, 38 M; F:M=1.58] had an average of 2.2 headache episodes during the previous three months (SD=1.0; min=0, max=6), a PedMIDAS total score of 1.3 (SD=1.3; min=0, max=5) and a pain score of 2.9 (SD=1.1; min=2, max=6). The third group [38 children (16%), 23 F, 15 M; F:M=1.53) reported about five episodes of headache during the previous three months (mean=4.9; SD=3.2; min=1, max=15) with a PedMIDAS total score of 5.5 (SD=5.4; min=0, max=21) and a pain score of 6.9 (SD=2.3; min=2, max=10). Thus, in terms of headache, the first group may be labeled as "absent pain", the second as "sporadic, low-impact, mild pain", the third as "non sporadic, moderate-impact, severe pain".

The main demographic, anthropometric and clinical characteristics of the groups are summarized in Table 1. **(insert here Table 1)**

The univariate models indicated that age, sex, BMI, waist circumference, forearm circumference, gestational hypertension and fish eating may discriminate among the three headache clusters (Table 2). **(insert here Table 2)**

As detailed in Table 3, **(insert here Table 3)** all such variables but sex seem to discriminate the cluster characterized by moderate headache and that without headache. For each year of growth, the odds of being affected by moderate headache increased by 40%.

The three anthropometric measures were consistently and positively associated to moderate headache: 11% odds increase for each unitary BMI increase, 5% odds increase for each additional centimeter of waist circumference, 15% odds increase for each additional centimeter of forearm circumference.

A positive but not significant correlation was found between physical activity and headache (no physical activity: 31% headache absence vs. 48.6% moderate headache presence; regular physical activity: 50% headache absence vs. 37.1% moderate headache presence).

Eating fish, more than twice a week decreased the odds of severe headache (0.16 when compared to zero times per week and 0.40 when compared to once a week).

No other significant correlations were found between living habits and headache in our study.

Finally, gestational hypertension seemed to be able to discriminate moderate from no-headache, with a very high odds ratio (7.6). However, the number of children whose mothers were affected by gestational hypertension was very small (n=12, 4.9%), resulting in a wide confidence interval (1.4-40.9).

As shown in Table 4, the first multi-variable model indicated that only sex and waist circumference were confirmed as significant "predictors" of headache. For both comparisons (mild vs. no-headache and moderate vs. mild-headache) females resulted, for each age group, at higher risk with an odds ratio of about 2. On the other hand, waist circumference increase was confirmed to be associated to a higher risk of moderate headache. Since waist circumference and BMI were strongly correlated (r=0.75, p<0.001), a second model was derived after excluding waist circumference. Model 2 indicated that females were at higher risk of both types of headache (even if the OR for moderate vs. no headache was marginally significant, p=0.064) and BMI paralleled the effect of waist circumference. Fig. 2 plots the predicted probabilities of headache according to sex and BMI/waist circumference (Insert here fig 2).

Discussion

Our study substantially confirms the data of estimated overall prevalence in European children under 10 years of age which ranged from 21% to 56%.1 The higher prevalence of headache (57,2%) in our population could be related to study design (i.e. PedMIDAS as screening tool of headache) or to geographical differences.[19]

Various papers have already reported a positive correlation between obesity and pediatric headaches.7,8,9,10,11 Although the reported percentage of obesity in the considered samples referred among studies (from 17.7% to 39.8%) and the prevalence of overweight considered a different BMI percentile (>85th in some studies, >95th in other ones), most studies demonstrated that primary headaches occur more frequently in overweight than in normal-weight children. That is mostly true for migraine6,8,10,20 while controversial results were found for tension type headache.9,10 It is also true that the pediatric headache group as a whole had a greater percentage of overweight than the general population.9,11 Attacks frequency6,10,21 and disability10,21 were higher in overweight than in normal-weighted children. Significant improvement in both adiposity and headache data, frequency and intensity, use of acute medications, and disability were observed in obese adolescents with migraine who participated in a 12-month-long interdisciplinary intervention program for weight loss.[20]

Also dietary habits, i.e. food quality, are associated with headaches. In a recent study11 performed on 550 students with migraine between 9 and 18 years, 252 subjects (45.8%) stated that the attacks were triggered by food: 19.6%: Coca-Cola® and coffee, 9.1%: fried food, 3.1%: spicy food, <3% each: chocolate, cheese, tea, peanuts. Coca-Cola®, caffeine, tea consumption was significantly higher in children with migraine than in those without. In our study, only fish eating in the univariate model was able to discriminate the three children groups considered. Though unconfirmed at the multivariable analysis, this finding is biologically plausible because the ant-inflammatory properties of PUFAomega-3 might contribute to prevent headache. However, in literature the evidence from PUFA supplementation is controversial: omega-3 supplementation could reduce frequency, duration and intensity of headache in 27 adolescents22 suffering from frequent migraines, but another double blind randomized clinical trial denied any effect of omega-3 supplementation.[23]

The study had a capillary evaluation of both EKG and echocardiographical parameters at disposal. However, no measure resulted to be associated with the risk of having a high risk among groups to have severe headache. Unfortunately, we could not find a comparable set of cardiovascular measures in this class of age. This likely reflects the fact that both EKG and echocardiographic changes related to pressure or volume ventricular overload require several years to develop. Accordingly, they are expected to correlate with headache in adulthood.

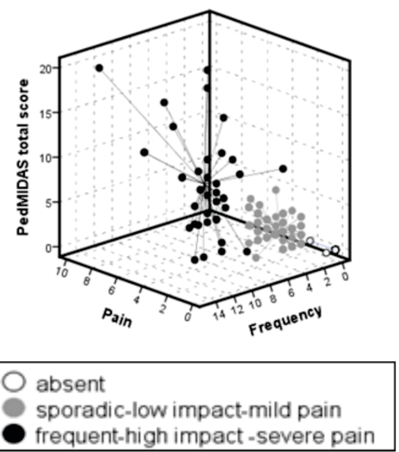
Age resulted significant only in the univariate analisys. We showed that for each year of growth, the odds of being affected by moderate headache increased by 40%. A progressive change of nociceptive system may have occurred throughout childhood, undergoing a series of transitional functional states before reaching maturity.24 This age-related prevalence of headache in young children could be more relevant in girls than in boys.[25]

Our study has some limitation. Although the whole sample size of children could be considered adequate for estimating prevalence (with n=238, standard error is below 3.2%) and for multivariate analysis (with 20 variables and n=238, Case-per-Variable ratio was 11, above the conventional threshold of 10), the relatively small sample of moderate headache (n=38) should be considered a limitation for a reliable identification of discriminant variables. In addition, such group was characterized by a moderate headache, but with a relatively low impact on daily activities.

Conclusions

Caring pediatric headache is not a simple task. Thus, improving our knowledge of headache correlates in order to modify them and, in the event of a causal relationship, to prevent headache, is an appealing strategy. In this perspective, our study shows that overweight qualifies as an important correlate of pediatric headache. This finding confirms a relationship being true in the adulthood26 and, then, stresses the need for interventions aimed at maintaining or restoring normal weight also in the adolescence.21 Our findings need to be confirmed in much larger samples, however they seem strong enough to recommend carefully assessing the effect of weight normalization on headache frequency and severity in overweight children and to adopt a healthy lifestyle before 10 years of age to prevent headache worsening in adolescents and young adults, particularly in girls.

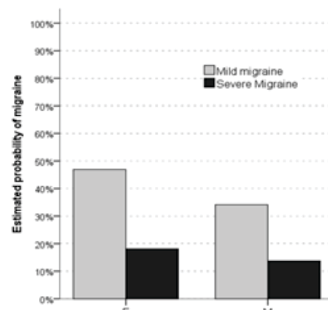
Figure 1

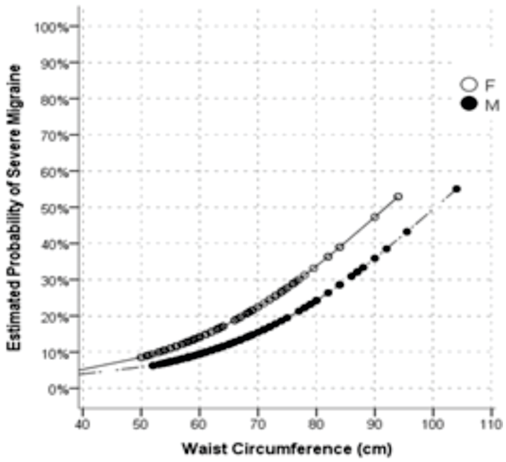


Figures Legends

Figure.1 Graphical representation of the three clusters in terms of migraine frequency, pain and PedMIDAS total score. The first cluster (white circles) identifies the 102 children without migraine, the second (gray circles) the 98 children with mild migraine, the third (black circles) the 38 children with severe migraine.

Figure 2





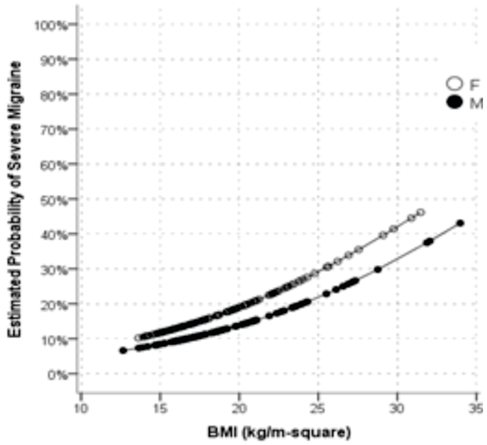


Figure. 2 Estimated probability of migraine according to the multinomial multivariable logistic model.

Tables

Table. 1 Descriptive statistics of the main demographic, anthropometric and clinical characteristics of the three groups, identified by cluster analysis

	WholeSample (n=238)	Headache clusters							
		absent (n=102, 43%)	mild (n=98, 41%)	moderate (n=38, 16%)					
Sex (n, %)	F	127	54%	44	43%	60	61%	23	61%
	M	111	47%	58	57%	38	39%	15	40%
Age, years (n, %)	6	27	11%	14	14%	11	11%	2	5%
	7	51	22%	23	23%	24	25%	4	11%
	8	48	20%	20	20%	20	20%	8	21%
	9	48	20%	22	22%	17	17%	9	24%
	10	64	27%	23	23%	26	27%	15	39%
Cesarean delivery (n, %)	114	48%	45	44%	51	52%	18	47%	
Birth weight, kg (mean, SD)	3.2	0.5	3.2	0.5	3.2	0.5	3.2	0.5	
Weight, kg (mean, SD)	34.3	9.8	33.4	8.5	33.6	9.8	38.6	11.8	
Height, cm (mean, SD)	133.5	9.0	132.6	8.3	133.2	9.7	135.8	7.6	
BMI, kg/m2 (mean, SD)	19.0	3.9	18.8	3.5	18.6	3.8	20.6	4.8	
BMI <10th centile (n,%)	8	3.4	2	2.0	5	5.1	1	2.6	
BMI 10-90 centile (n,%)	145	60.9	66	64.7	61	62.2	18	47.4	
BMI >90 centile (n,%)	85	35.7	34	33.3	32	32.7	29	50.0	
Waist circumference, cm(mean, SD)	64.4	10.3	63.6	8.3	63.1	10.3	69.4	13.0	
Arm circumference, cm (mean, SD)	20.8	2.6	20.8	2.3	20.5	2.7	21.8	3.0	
Systolic Blood Pressure, mmHg (mean, SD)	98.7	11.0	97.5	10.3	99.5	11.6	99.8	11.3	
Diastolic Blood Pressure, mmHg (mean, SD)	65.1	7.5	64.5	7.8	65.8	7.3	65.0	6.7	
Cardiovascular familiarity (n, %)	88	37%	37	36%	36	37%	15	39%	
Physical Activity	None	76	32.8%	31	31.0 %	28	28.9 %	17	48.6 %
	Occasionally	39	16.8%	15	15.0 %	19	19.6 %	5	14.3 %
	Regular	117	50.4%	54	54.0 %	50	51.5 %	13	37.1 %
TV, computer, videogames	0-1 hours/day	94	41.0%	32	33.0 %	46	48.4 %	16	43.2 %
	2-3 hours day	84	36.7%	43	44.3 %	29	30.5 %	12	32.4 %
	>3 hours/day	51	22.3%	22	22.7 %	20	21.1 %	9	24.3 %

Table. 2 Multinomial uni-variable logistic regression analysis. Likelihood Ratio test.

Variable	LR test	df	uncorrected p-value
Age (years)	6.144	2	0.046
Sex (F, M)	7.529	2	0.023
Father BMI (kg/m2)	3.409	2	0.182
Mother BMI (kg/m2)	5.646	2	0.059
Mother's weight at term of pregnancy (kg)	1.039	2	0.595
GestationalHypertension (Yes, No)	6.305	2	0.043
Cesarean delivery (Yes, No)	1.263	2	0.532
Preterm delivery (Yes, No)	0.436	2	0.804
Passive Smoking (Yes, No)	1.770	2	0.413
BMI (kg/m2)	7.050	2	0.029
BMI Percentile	5.605	2	0.061
Waistcircumference (cm)	10.711	2	0.005
Forearmcircumference (cm)	6.505	2	0.039
Systolic Blood Pression (mmHg)	1.984	2	0.371
Diastolic Blood Pression (mmHg)	1.668	2	0.434
Hearth rate	0.223	2	0.894
PR	1.458	2	0.482
QRS	2.859	2	0.239
Asse_QRS	1.308	2	0.520
QT	0.580	2	0.748
QTc	3.043	2	0.218
LVIDd	1.083	2	0.582
LVPWd	3.653	2	0.161
IVSd	1.121	2	0.571
EDV	1.450	2	0.484
EF	1.436	2	0.488
DiamAo	1.576	2	0.455
LADiam	5.328	2	0.070
MV E/A	0.090	2	0.956
AV_Vmax	1.958	2	0.376
AV_Vmean	1.791	2	0.408
AV_maxPG	1.591	2	0.451
AV_mediaPG	2.656	2	0.265
Outdoor playing activity (Yes, No)	0.132	2	0.936
Cycling (Yes, No)	0.059	2	0.971
Physical activity (none, occasional, regular)	5.272	4	0.261
TV Computer Videogames (<=1, 2-3, >3 h/day)	5.698	4	0.223
Eatingfried (0, 1, >=2 times/week)	7.326	4	0.120
Eatingcheese (0, 1, >=2 times/week)	5.302	4	0.258
Eatingfish (0, 1, >=2 times/week)	10.839	4	0.028
Eatingmeat (<=3, 4, >4 times/week)	5.341	4	0.254
Eating pasta/bread (<=4, >4 times/week)	1.221	2	0.543
Eatingsweets (0, 1, 2-3, >=4 times/week)	2.613	6	0.856
Eatingvegetable (0, 1, 2-3, >=4 times/week)	9.842	6	0.131
Eatingfruit (0, 1, 2-3, >=4 times/week)	2.156	6	0.905
Drinkingjuices (0, 1, 2, >=3 times/week)	8.317	6	0.216
Drinking orangeade/coke (0, 1, >=2 times/week)	3.810	4	0.432
Eatingsnacks (0, 1, 2-3, >=4 times/week)	2.353	6	0.885
Familiarity: Hypertension(Yes, No)	2.557	2	0.278
Familiarity: Coronary heart disease (Yes, No)	0.389	2	0.823
Familiarity: Diabetes(Yes, No)	1.314	2	0.518
Familiarity: Hyperlipidemia(Yes, No)	0.260	2	0.878
Familiarity: Cerebrovascular disease (Yes, No)	2.119	2	0.347
Familiarity for cardiovascular disease (Yes, No)	0.125	2	0.939

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