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Parental psychopathology and migraine headaches among adolescent girls

NR Marmorstein[1], **WG Iacono**[2], and **CN Markey**[1]

1*Rutgers University, Camden, NJ, USA*

2*University of Minnesota, Minneapolis, MN, USA*

Abstract

Migraine headaches and depression often co-occur within individuals, and both syndromes run in families. However, knowledge about how these disorders relate across generations, as well as how migraine relates to other forms of psychopathology, is sparse. This study examined risk for migraine among female adolescent offspring of parents with different types of psychopathology. The sample was drawn from the Minnesota Twin Family Study, a community-based study of adolescents and their families (*n* = 674, 17-year-old female adolescents and their biological parents). Diagnoses of maternal, paternal and offspring major depression, antisocial behaviour, alcohol dependence and drug dependence were based on structured interviews. Migraine headaches in each family member were assessed via interviews with the mother. Parental depression, antisocial behaviour and drug dependence were associated with offspring migraine. These associations mostly remained significant even when parental migraine and the corresponding type of psychopathology in offspring were adjusted for. In contrast, there were no significant associations between parental psychopathology and offspring stomach problems, indicating that these associations did not extend to all offspring somatic symptoms. These results emphasize the need to look at antisocial behaviour and substance-related problems when examining associations between migraine and psychopathology, and indicate that more research on inter-generational links between migraine and psychopathology is needed.

Keywords

Migraine; depression; antisocial behaviour; substance dependence; psychopathology

Introduction

Major depressive disorder (MDD) and migraine headaches often co-occur within individuals (1-6); MDD may also be linked to other severe, chronic headaches among children and adolescents (7,8). Longitudinally, MDD predicts migraine and migraine predicts MDD [(9-11), although one study found that affective disorders did not predict later migraine (12)]. Across generations, it is clear that offspring of parents with depression are at risk for depression (13) and offspring of parents with migraine are at risk for migraine (4,14,15). However, whether offspring of parents with MDD are at risk for migraine is unclear.

The findings described above have led some researchers to posit a shared causal mechanism between migraine and MDD (10,11,16), although the nature of this mechanism remains unclear. Consistent with this notion, the pattern of development of the two disorders appears

Naomi R Marmorstein, PhD, Department of Psychology, Rutgers University, Camden, 311 North 5th Street, Camden, NJ 08102, USA. E-mail E-mail: marmorst@camden.rutgers.edu.

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to be quite similar: prior to adolescence, both problems are relatively rare and occur at approximately equal rates in male and female; however, rates of both problemsincrease rapidly in female but only slowly and to a lesser degree in male adolescents (9). If there is a shared genetically based causal mechanism, there should be an association between MDD and migraine among relatives. However, a family study (4) has reported that rates of anxiety/depression were not elevated in relatives of probands with migraine, and rates of migraine were not elevated in relatives of probands with anxiety/depression—suggesting that there may not be familial associations between these problems aside from the within-person associations. Therefore, it remains unclear whether there truly is a shared causal mechanism.

Research examining associations between migraine and other forms of psychopathology, including antisocial and substance-related pathology, is sparse. However, such information could be useful in clarifying whether the association between migraine and psychopathology is unique to MDD or whether it represents a more general association between migraine and psychological problems in general. One study has reported an association between conduct disorder and chronic headaches in 9-15-year-old boys (7), although another study failed to find a significant association between migraine and antisocial personality disorder among young adults (17). These inconsistent findings could be due to the differing ages of the samples, the fact that one comprised males only whereas the other included both males and females, or the fact that antisocial personality disorder represents a more severe, ongoing pattern of antisocial behaviour than does conduct disorder. Of the studies examining within-person associations between substance use-related problems and migraine, one reported no significant association in a community-based sample of adults (12); however, in a different community-based sample of adults, there was a significant association between migraine and both illicit drug abuse/dependence and alcohol abuse/dependence (16). It is unclear why these two community-based samples of adults yielded these discrepant findings, although the latter sample (16) was somewhat younger than the former (12).

The present study examined whether parental psychopathology was associated with risk for migraine in offspring. This study was limited to adolescent girls due to the low prevalence of migraine among adolescent boys (3% in our sample) and resulting low statistical power. We expected that MDD in parents would be associated with migraine among female offspring, although it was unclear whether this effect would remain significant once we adjusted for potentially co-occurring migraine among parents and potentially co-occurring MDD among offspring.

In this study, we also examined two related questions in order to investigate whether any links found between parental MDD and offspring migraine were specific or simply represented more general associations between parental psychopathology and offspring somatic symptoms. This question of specificity has important implications for aetiology. If there is a broad association between all forms of parental psychopathology and all types of somatic symptoms in offspring, that would point toward either a broad psychosocial risk model (e.g. the stress of living with a parent with psychopathology increases risk for somatic problems in children) or a broad shared vulnerability (e.g. difficulties with emotion regulation relate to increased risk for many forms of psychopathology and also many forms of somatic problems). In contrast, if there is a specific association between parental MDD and offspring migraine—and not other forms of parental psychopathology or offspring somatic problems—that would point toward a shared mechanism that was specific to those two problems (e.g. something related to hormones, given the increased prevalence of both problems among females beginning in adolescence). Therefore, in addition to examining parental MDD, we included parental antisocial behaviour, alcohol dependence and drug dependence to examine whether the (potential) association between parental psychopathology and offspring migraine was specific to MDD or represented a more general association between migraine and parental psychopathology. Due to the lack

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of prior research on associations between migraine and antisocial and substance-related psychopathology, no specific predictions were made for analyses examining these links. Second, in an attempt to clarify whether any associations found were unique to offspring migraine or were more general (i.e. related to a variety of types of offspring somatic symptoms), we examined links between these forms of parental psychopathology and offspring stomach-related problems. Due to the association between abdominal symptoms and depression (18), we expected that parental MDD would be associated with offspring stomach problems. Due to lack of prior research in the area, no predictions were made for analyses examining links between parental antisocial and substance-related psychopathology and offspring stomach problems.

Method

Participants

Participants in this study were drawn from the community-based sample of the Minnesota Twin Family Study (MTFS), a longitudinal study of twins and their parents. The MTFS was initiated to investigate factors that are associated with psychopathology and substance use—including general health—and therefore provided an ideal sample in which to investigate cross-generation associations between migraine and psychopathology. Female twins born in the state of Minnesota during specified birth years were identified; after excluding those twins who were adopted, had a disability that precluded participation or lived more than a day's drive from Minneapolis, over 82% participated in the study. Among people who did not participate, some refused or did not agree to an assessment date, some were unavailable because of severe illness or death, and some were unavailable due to other reasons (out of the country, in jail, or not able to be located). Adolescents were approximately 17 years old at the time of their visit to the study [mean 17.5 (s.d. = 0.5); range 17-19]. The present sample includes the 674 females (all same-sex twins) who were assessed and their biological parents [337 mothers (mean age 44.2 years, s.d. = 5.0, range 33-60 years), 288 fathers (mean age 46.5 years, s.d. = 5.3, range 35-63 years)].

Families visited the study and completed a day-long series of psychological and psychophysiological assessments relating to risk for a broad range of psychopathology and other problems. A substantial component of this assessment involved the structured interviews used in this study. Each participant was assessed by a different interviewer; all interviewers had bachelors or masters degrees in psychology or a related field and had received extensive training in diagnostic interviewing. Interviews were then reviewed by teams of advanced clinical psychology doctoral students, who reached consensus on the presence or absence of each symptom based on the information provided and guidelines developed with doctoral-level clinical psychologists. Kappa reliabilities for all psychiatric diagnoses included in this study were ≥ 0.85.

As appropriate, written consent from parents and assent from children was obtained, and this study was approved by the University of Minnesota's Institutional Review Board.

The sample was predominantly (98%) White, as expected given the demographic make-up of Minnesota at the time the twins were born. Average socioeconomic status levels corresponded to parental occupations such as clerical and sales workers and small business owners. An analysis comparing participating and non-participating families on a range of demographic factors as well as self-reported alcoholism and depression provided little evidence of participation bias, and participating families were broadly representative of Minnesota families with children according to the 2000 US Census. Full details regarding the design of this study and sample characteristics are provided elsewhere (19-21).

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Measures

Major depressive disorder—MDD was assessed using the Structured Clinical Interview for DSM-III-R [SCID (22)]. Each participant reported on their own symptoms of MDD. The disorder was considered present if the participant met criteria for a definite or probable (missing one symptom) episode at any point in their lifetime.

Antisocial behaviour—Diagnostic and Statistical Manual of Mental Disorders (DSM)-III-R conduct disorder (CD) was assessed using a modified version of the Structured Clinical Interview for DSM-III-R Personality Disorders [SCID-II (23)]. Consistent with DSM specifications, CD was assessed prior to age 15 years. DSM-III-R adult antisocial behaviour (AAB; the symptoms of antisocial personality disorder that must occur in adulthood) was assessed using a modified version of the Structured Clinical Interview for DSM-III-R Personality Disorders [SCID-II (23)]. Consistent with DSM specifications, AAB was assessed after age 15 years. Each participant reported on their own symptoms of CD and AAB. If a lifetime history of either CD or AAB was present at a definite or probable level in a particular participant, that participant was considered to evidence lifetime antisocial behaviour (ASB).

Alcohol and drug dependence—Alcohol dependence and illicit drug dependence were assessed via structured interviews [the Substance Abuse Module (24), a supplement to the Composite International Diagnostic Interview (World Health Organization (25)]. Each participant reported on their own symptoms of alcohol and drug dependence. Symptoms occurring at any point in the participants' lives were assessed. Both definite (meeting all DSM-III-R criteria) and probable (missing one symptom) diagnoses were used. Although dependence on 12 types of illicit drugs was assessed separately, they were combined into a dichotomous 'presence vs. absence of dependence on any illicit drug' variable for the purposes of this study.

Migraine headaches—Mothers reported on a variety of health problems that they, their daughters (the twins) or the fathers may have experienced. If a mother reported that she, her daughter(s) and/or the father had experienced migraine headaches (on a global question asking whether that family member had ever experienced them), that participant was considered to have migraines.

Stomach-related problems—During the same interview that assessed migraine headaches, mothers reported on whether they, their daughters (the twins) and/or the fathers had experienced 'stomach trouble' (on a global question asking whether that family member had ever experienced stomach trouble). If the mother reported that a family member had experienced 'stomach trouble', that participant was considered to have stomach-related problems.

Statistical analyses

First, rates of each disorder (migraine, stomach problems, MDD, ASB, alcohol dependence and drug dependence) were computed for each family member (adolescent girl offspring, mothers and fathers). Next, in order to describe within-person associations among these problems in this sample, χ^2 analyses examining associations between migraine and each type of psychopathology in each family member were conducted; these analyses were then repeated using stomach problems instead of migraine. We also described the associations between parental and child somatic problems by conducting χ^2 analyses examining the associations between either parent having (i) migraine and (ii) stomach problems and the offspring having the same problem. Finally, we described the association between migraine and stomach problems among offspring.

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Primary analyses were conducted using the SAS PROC GENMOD procedure. This procedure is appropriate for examining associations between categorical variables (i.e. yes/no diagnoses) when correlated observations (i.e. twin offspring) are present. Thus, all analyses adjusted for the inclusion of two participants (twin offspring) from each family (i.e. non-independent observations) by using generalized estimating equations. This form of statistical adjustment is common practice in studies using nested data (e.g. siblings nested within families, children nested within classrooms) and yields more accurate estimates of effects than statistical techniques that do not account for these correlated observations. Because the statistical tests adjusted for the fact that there were two offspring from each family in this sample, the results presented here can be interpreted as though the adolescents did not have twin siblings in the sample.

Maternal and paternal diagnoses were combined for the primary analyses (i.e. if either parent had a history of the disorder being examined, it was considered present). First, in order to examine overall associations between parental psychopathology and offspring migraine, we modelled the likelihood of offspring migraine given parental (i) MDD, (ii) ASB, (iii) alcohol dependence and (iv) drug dependence. Next, in order to examine whether the associations found were due to within-person associations between migraine and psychopathology among parents, we modelled the likelihood of offspring migraine given each parental diagnosis while adjusting for parental migraine. Finally, in order to examine whether the associations found were due to within-person associations between migraine and psychopathology among offspring, we added the relevant offspring diagnosis to the model in order to adjust for its potential co-occurrence with offspring migraine. These three sets of analyses were then repeated considering stomach trouble instead of migraine headaches in order to examine whether the pattern of associations was similar for these two offspring somatic problems. We also repeated the migraine analyses considering mothers only (rather than combining maternal and paternal diagnoses) due to the possibility that migraine and psychopathology have different associations in males and females. These analyses yielded odds ratios (ORs) representing the increase in risk associated with having a parent with the disorder, relative to having a parent without the disorder. An OR of 1 indicates equivalent levels of risk among offspring with parents with and without the disorder, whereas higher ORs indicate increased risk among offspring with parents with the disorder. Confidence intervals (CIs, 95%) for the ORs are also presented in order to indicate the likely range of outcome values.

For all analyses, resulting P-values < 0.05 were considered significant; P-values < 0.10 but > 0.05 were noted as trend-level associations.

Results

Sample characterization and associations among disorders

Rates of migraine, stomach problems and psychiatric disorders among the girls and their parents are presented in Table 1. ORs and 95% CIs representing the within-person associations between each form of psychopathology and migraine and stomach problems are also presented in Table 1. The only significant findings indicated that migraine and stomach problems were associated with MDD among girls and mothers, and alcohol dependence was associated with stomach problems in girls.

Among adolescents, migraine and stomach trouble were associated with each other (OR 2.86, 95% CI 1.16, 7.05). Of those with stomach trouble, 18% also had migraine and 14% of those with migraine also had stomach trouble.

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Familial resemblance for health status

Both migraine and stomach problems tended to run in families. Offspring with at least one parent with a history of migraine were at increased risk for migraine (OR 5.02, CI 2.95, 8.56) and offspring with at least one parent with a history of stomach problems were at increased risk for stomach problems (OR 4.80, CI 2.26, 10.17).

Given this study's migraine focus and the incidental use of a twin sample, we examined concordance for migraine among our monozygotic (MZ) and dizygotic (DZ) twin pairs. Consistent with twin studies on migraine [e.g. (26)], significant similarity was observed for MZ twins ($R = 0.43$, $P < 0.001$, $n = 223$ pairs) but not for DZ twins ($R = 0.00$, NS, $n = 114$ pairs), and the MZ similarity was significantly greater than that evident for the DZ twins ($P < 0.001$). For stomach problems, significant similarity was observed for both MZ ($R = 0.43$, $P < 0.001$, $n = 223$ pairs) and DZ ($R = 0.33$, $P < 0.001$, $n = 114$ pairs) twins; the MZ similarity was not significantly greater than that evident for the DZ twins ($P > 0.05$).

Associations between parental psychopathology and offspring migraine

As shown in Table 2, offspring of parents with MDD, ASB and drug dependence were at significantly increased risk for migraine. Offspring of parents with alcohol dependence were almost twiceas likely as other girls to have migraines, although this association was only significant at a trend level. Thus, girls whose parents have a wide variety of forms of psychopathology are at risk for migraine.

Associations between parental psychopathology and offspring migraine, adjusting for parental migraine

When the effect of parental migraine was adjusted for, the pattern of results remained similar (Table 2). As would be expected based on the fact that within-person associations between migraine and ASB, alcohol dependence and drug dependence were all non-significant, ORs representing risk to offspring associated with these disorders among parents were quite similar to those found when parental migraine was not adjusted for (and the pattern of significant findings was identical). When parental MDD was considered, as would be expected given significant within-person associations between MDD and migraine, the OR dropped a small amount and as a result was significant only at the trend level. Thus, even when co-occurring parental migraine is adjusted for, significant associations remain between a range of parental psychopathology and offspring migraine.

Associations between parental psychopathology and offspring migraine, adjusting for parental migraine and offspring psychopathology

Finally, analyses adjusting for potentially co-occurring disorders in the offspring were conducted (Table 2). Once offspring MDD as well as parental migraine were adjusted for, the association between parental MDD and offspring migraine was non-significant, although the OR was still in the expected direction. When the effects of parental migraine and offspring alcohol dependence were adjusted for, the association between parental alcohol dependence and offspring migraine remained significant at the trend level. Associations between parental ASB and drug dependence and offspring migraine remained significant when both parental migraine and the relevant disorder in the offspring were adjusted for. Thus, overall, when the effects of relevant disorder in offspring as well as parental migraines were adjusted for, the link between parental MDD and offspring migraine was slightly reduced, whereas the links between other parental disorders and offspring migraine remained similar.

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Analyses examining offspring stomach problems

As shown in Table 3, associations between parental psychopathology and offspring stomach problems were non-significant. Although there was a trend-level ($P < 0.10$) association between parental alcohol dependence and offspring stomach problems, this association was non-significant once parental stomach problems and offspring alcohol dependence were adjusted for.

Associations between maternal psychopathology and offspring migraine

Due to the gender differences in the prevalence of migraine, as well as the fact that migraine and MDD were significantly associated among mothers but not among fathers, we re-ran all three sets of parental psychopathology-offspring migraine analyses (overall, adjusting for parental migraine, and adjusting for both parental migraine and offspring psychopathology) examining only mothers. The pattern of significant results remained the same, although a couple of the trend-level associations were reduced to non-significance (the maternal MDD-offspring migraine associationwhen adjusting for maternal migraine and all analyses examining links between maternal alcohol dependence and offspring migraine). Therefore, the pattern of results is similar when mothers only are examined, compared with when parents are examined together.

Discussion

The results of this study indicate that adolescent female offspring of parents with a range of psychopathology are at risk for migraine headaches. This effect was not primarily related to parental MDD; in fact, associations between parental ASB and drug dependence and offspring migraine were particularly strong. For the most part, these associations remained significant even once the effects of parental migraine and the relevant type of offspring psychopathology had been statistically adjusted for. Therefore, these effects are not simply due to the co-occurrence of migraine and psychopathology within individuals.

In contrast, parental psychopathology was not generally associated with risk for stomach problems among adolescent female offspring (although there was a weak association between parental alcohol dependence and offspring stomach problems). Therefore, it seems that the broad associations between parental psychopathology and migraine headaches in offspring are not simply due to a general association between parental psychopathology and all types of somatic problems in offspring.

Serotonin dysregulation has long been linked to depression and also appears to be important in the pathophysiology of migraine (27). There is also evidence of serotonergic involvement in antisocial behaviour (28) and alcoholism (29). It is clear that identical serotonin dysregulation does not underlie all of these problems [for example, selective serotonin reuptake inhibitors, shown to be effective in the treatment of depression, are not an effective treatment for alcoholics as a group (29)]. However, given the diversity of types of serotonin receptors, it seems possible that, broadly speaking, dysregulation in this neurotransmitter could relate to risk for all of these problems. Of course, there are many other possible factors that could underlie both these psychiatric disorders and migraine, including stress and family dysfunction. However, one would expect that these factors would also be associated with stomach problems; the lack of association between these parental psychiatric disorders and offspring stomach problems points to a more specific mechanism between these parental psychiatric disorders and offspring migraine. Future research examining the mechanism behind these findings would be useful.

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Our findings relating to parental MDD and offspring migraine have indicated that although there was a clear overall association between parental MDD and migraine among adolescent female offspring, after adjusting for parental migraine and offspring MDD (i.e. within-person comorbidity between these problems), this association was diminished. This marginal association is similar to the findings of another study (4), which reported that anxiety/depression in probands was not associated with risk for migraine in relatives, and migraine in probands was not associated with risk for anxiety/depression in relatives.

Associations between offspring somatic problems and parental alcohol dependence were slightly different from those between offspring somatic problems and parental ASB and drug dependence. Specifically, associations with offspring migraine were present only at a trend level (i.e. a weaker association than ASB and drug dependence), and associations with offspring stomach problems werealso present at a trend level (i.e. a stronger association than ASB and drug dependence). Furthermore, there was a significant within-person association between stomach problems and alcohol dependence among offspring (although this was not found for ASB or drug dependence or for within-person associations between ASB, alcohol, or drug dependence and migraine). It is possible that the link between parental alcohol dependence and offspring stomach problems are related to stomach problems associated with after-effects of alcohol consumption in offspring; this is supported by the fact that once offspring alcohol dependence was adjusted for, the association between parental alcohol dependence and offspring stomach problems was non-significant. Given the trend-level association between parental alcohol dependence and offspring migraine, however, it is also possible that for some reason alcohol dependence differs from ASB and drug dependence in the risk for somatic problems that it confers to offspring. Further research into this question would be helpful.

Our findings of stronger associations between parental drug dependence, compared with parental alcohol dependence, and offspring migraine is consistent with the findings of Breslau and colleagues (16), who found a within-person association between migraine and drug dependence but not between migraine and alcohol dependence [although the OR in that study was in the expected direction and only slightly smaller than ours (OR = 1.5)]. Our finding of an association between parental ASB and offspring migraine is similar to that of Egger and colleagues (7), who reported a within-person link between headaches and conduct disorder among boys, but not to that of Merikangas and colleagues (17), who reported no significant association between migraine and antisocial personality disorder in adults. This may be because our diagnosis of ASB in parents probably captured less severe cases than the Merikangas study, which examined more severe cases of antisocial personality disorder.

Our examination of parent-offspring associations between psychopathology and migraine represents a novel contribution to the literature. In addition, our inclusion of antisocial behaviour and substance-related psychopathology, as well as depression, among the parents represents a significant contribution. Of course, there are also limitations to this study. The assessment of migraine was not thorough enough to assign migraine diagnoses based on the criteria of the International Headache Society (IHS). Although this represents a true limitation, several facts support the validity of our diagnoses of migraine. The prevalence in this sample was similar to that found in other studies that used structured assessments of the IHS criteria for migraine (1,5,9,30). We confirmed the female predominance of migraine reported in other studies [e.g. (1,5,9,30)]. We also confirmed the association between migraine and MDD among female subjects reported in other studies [e.g. (1-6)]. Finally, as expected given other research on the behaviour genetics of migraine (26,31), we found that migraine ran in families and showed greater similarity in MZ vs. DZ twins. Therefore, although clearly our assessment of migraine was less than ideal and the results should therefore be interpreted with caution, the resulting data appear to be similar to those obtained from more well-validated methods of assessing migraine.

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This study also has other, more minor limitations. Although representative of the state of Minnesota at the time the twins were born, the sample was overwhelmingly (98%) White. It is unclear how these findings would generalize to other racial or ethnic groups. It is also possible that the use of twin adolescents in this study could limit its generalizability to non-twins, although available evidence indicates that twins are similar to non-twins in rates of psychopathology (32) and other characteristics (33,34). Diagnoses of migraine were based on maternal reports only; although this is not ideal and may result in the overestimation of familial aggregation of migraine and/or be biased because the mothers are the same sex as their daughters, it cannot account for this study's findings regarding associations between psychopathology and migraine in families. The adolescent girls in this study were not past the peak ages for developing migraine; therefore, more of them may develop migraine in the future. We did not specifically ask whether the stomach problems reported were related to migraine (i.e. migraines can sometimes present with nausea and/or vomiting); although it seems unlikely that this substantially affected the results since only approximately 15% of adolescents with one of these problems had the other as well, we cannot rule out this possibility. Our rates of ASB and substance use disorders among parents are higher than in many studies; this reflects the fact that both probable and definite diagnoses occurring at any point in the participants' lives (and in the case of ASB, a lifetime diagnosis of either conduct disorder or adult ASB) were used. Thus, some of the disorder 'cases' were less severe and reflect thefact that these disorders fall on a continuum. This makes our findings of significant associations across problems (psychopathology and migraine) across generations even more striking—these links are not only found in participants with severe cases of the disorders. In addition, this study did not examine possible mediators and moderators of these associations between parental psychopathology and offspring migraine; future research doing so would be informative.

The results of this study indicate that female adolescent offspring of parents with a variety of types of psychopathology—including antisocial and substance-related psychopathology—are at risk for migraine headaches. Future work explaining this association could lead to improved understanding and possibly improved preventative interventions and/or treatments for high-risk youth.

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Table 1

Prevalence of migraine, stomach problems and psychiatric disorders among 17-year-old adolescent girls, mothers and fathers

	Migraine	Stomach problems	Major depression	Antisocial behaviour	Alcohol dependence	Drug dependence
Girls (n = 674)	8.3%	6.2%	12.2%	7.9%	9.0%	4.9%
Risk for psychopathology, given migraine, OR (CI)			3.01 (1.67, 5.43)	1.46 (0.54, 3.94)	1.27 (0.51, 3.12)	1.56 (0.54, 4.56)
Risk for psychopathology, given stomach problems, OR (CI)			2.80 (1.40, 5.63)	1.64 (0.54, 4.98)	3.59 (1.63, 7.93)	1.54 (0.32, 7.41)
Mothers (n = 337)	20.5%	13.1%	33.6%	10.4%	12.8%	6.2%
Risk for psychopathology, given migraine, OR (CI)			1.76 (1.02, 3.03)	1.40 (0.62, 3.14)	1.84 (0.90, 3.76)	1.23 (0.43, 3.48)
Risk for psychopathology, given stomach problems, OR (CI)			2.74 (1.44, 5.21)	1.79 (0.73, 4.39)	0.86 (0.32, 2.32)	0.69 (0.15, 3.01)
Fathers (n = 288)	5.7%	7.8%	14.1%	42.0%	43.0%	14.9%
Risk for psychopathology, given migraine, OR (CI)			1.15 (0.32, 4.14)	1.57 (0.62, 3.99)	0.76 (0.29, 1.98)	2.16 (0.74, 6.35)
Risk for psychopathology, given stomach problems, OR (CI)			1.01 (0.28, 3.61)	0.53 (0.20, 1.40)	0.69 (0.27, 1.79)	1.88 (0.65, 5.42)

CI, 95% confidence interval; OR, odds ratio.

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Table 2

Odds ratios (95% confidence intervals) representing risk for migraine among offspring of parents with different forms of psychopathology

	Overall risk for migraine in adolescent girls	Risk for migraine in adolescent girls, adjusting for parental migraine	Risk for migraine in adolescent girls, adjusting for parental migraine and girls' psychopathology
Parental MDD	1.86** (1.01, 3.43)	1.71* (0.92, 3.17)	1.59 (0.86, 2.93)
Parental ASB	2.23*** (1.30, 3.81)	2.34*** (1.36, 4.01)	2.38*** (1.39, 4.08)
Parental alcohol dependence	1.82* (0.92, 3.57)	1.84* (0.93, 3.62)	1.83* (0.91, 3.67)
Parental drug dependence	2.55*** (1.26, 5.16)	2.72*** (1.36, 5.46)	2.68*** (1.31, 5.50)

ASB, antisocial behaviour; MDD, major depressive disorder.

* $P < 0.10$

** $P < 0.05$

*** $P < 0.01$.

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Table 3

Odds ratios (95% confidence intervals) representing risk for stomach problems among offspring of parents with different forms of psychopathology

	Overall risk for stomach problems in adolescent girls	Risk for stomach problems in adolescent girls, adjusting for parental stomach problems	Risk for stomach problems in adolescent girls, adjusting for parental stomach problems and girls' psychopathology
Parental MDD	1.46 (0.70, 3.05)	1.26 (0.61, 2.63)	1.16 (0.56, 2.43)
Parental ASB	1.02 (0.49, 2.13)	1.06 (0.50, 2.24)	1.05 (0.49, 2.24)
Parental alcohol dependence	2.08* (0.89, 4.88)	2.12* (0.91, 4.92)	1.92 (0.81, 4.55)
Parental drug dependence	0.44 (0.13, 1.48)	0.44 (0.12, 1.65)	0.44 (0.12, 1.71)

ASB, antisocial behaviour; MDD, major depressive disorder.

*$P < 0.10$.