GP consultations for medically unexplained physical symptoms in parents and their children: a systematic review

INTRODUCTION
Non-specific physical symptoms, such as musculoskeletal pain and headache, are widespread in the community and are among the most common reasons for visiting a GP. In the UK, recent research indicates that the annual GP consultation prevalence for musculoskeletal symptoms is 25% and for headache is about 4.4%.2,3 Many physical complaints remain medically unexplained, owing to lack of obvious cause or pathological changes on physical examination and diagnostic testing. Medically unexplained physical symptoms (MUPS) are defined as physical symptoms that lead the patient to seek health care, and after clinical assessment do not seem to be explained by a clearly defined cause or diagnosis of a defined medical disease.4,5

The majority of patients presenting in primary care with MUPS improve within a few weeks,6 although about one-quarter of patients experience persistent or recurrent MUPS.4 MUPS are also common among children, and persist in a considerable proportion of children.7-9 Recurrent or persistent MUPS among children are associated with excessive utilisation of healthcare services, functional impairment, and negative impact on the quality of life of children and parents.10-12 Children with MUPS are also at greater risk of developing other MUPS and psychiatric disorders later in life.7,13-14

The causes of MUPS are still poorly understood, but are likely to be multifactorial. Research evidence suggests that MUPS among children may be related to a number of factors, including stressful events related to schooling and social relationships,15,16 psychopathology,17,18 childhood abuse and neglect,19,20 pubertal development,21 and poor parental health.22,23

Several studies have demonstrated that parental health is related to the health of the child, particularly when parents experience MUPS. Parents with MUPS and/or anxiety or depression are more likely to have children with high GP attendance rates and perceive their children to have symptoms.24 Children of mothers with chronic somatisation disorder (MUPS for at least 2 years) are more likely to have health problems and more GP consultations than children of mothers with explained chronic illness or mothers without chronic illness.24 Similarly, children of mothers with irritable bowel syndrome (IBS) have more disability days and GP consultations for gastrointestinal (GI) and non-GI symptoms than children of mothers without IBS.25 Some studies have focused on the associations of parental MUPS between parents and children, and reported mixed results. A few studies found no associations for any pain (musculoskeletal pain, widespread pain, and non-specific low back pain [NLBP]).25 functional abdominal pain (FAP),26 and NLBP27 between parents and children. Conversely, other studies found significant associations for back pain or headache,28,29 and FAP between parents and children.30,31

As MUPS are a significant burden in...
primary care, it is important to know if the association of MUPS between parents and children is also present for GP consultations. It is important to identify and better understand possible associations of GP consultation for MUPS between parents and children. This study found evidence of an association between GP consultations for MUPS in parents and their children. GPs need to be aware of this link, which has implications for the management and prevention of MUPS among children in primary care.

METHOD
Search strategy
MEDLINE®, Embase, CINAHL, and PsycINFO bibliographic databases were searched from their inception to October 2012. Medical Subject Heading (MeSH) and free-text terms on MUPS and primary care were used to identify papers. (The detailed search strategy is available on request from the authors.) Additionally, the reference lists of relevant papers were examined and their citations traced using the Social Science Citation Index. No restrictions were imposed on the language of publication. Local experts were contacted to identify additional relevant studies.

Study selection
The selection included primary care and population-based observational studies that investigated the association between GP consultations for MUPS, medical diagnosis of functional somatic syndromes, or history of treated MUPS in parents and GP consultations for MUPS in children aged 1 to 17 years. It included studies in which GP consultation data for MUPS were obtained using primary care medical records, self-reported data, or both data sources. Only studies in which physical symptoms were operationally defined as MUPS or specifically referred to as functional, somatic, or non-specific were included. Studies were included regardless of the time period over which these associations had occurred.

The titles and abstracts of all studies were screened and irrelevant studies were excluded. Two reviewers assessed full-text papers to determine the eligibility of studies that appeared to meet the inclusion criteria, or when a defined decision could not be made based on the title and/or abstract alone. Any disagreements were resolved by consensus, or reconciled by a third reviewer.

Data extraction and quality assessment
Standardised forms were used for methodological quality assessment and data extraction. The following information was extracted: study setting, design, population, number of participants and their demographic characteristics, type of MUPS, data-collection methods, and outcomes of association of GP consultations for MUPS between parents and children.

The association of GP consultations for MUPS between parents and children was defined and measured as the association between GP consultations for MUPS, history of treated MUPS, or medical diagnosis of functional somatic syndromes in parents and GP consultations for MUPS in children. The methodological quality of included

How this fits in
There is evidence of an association of medically unexplained physical symptoms (MUPS) between parents and children, but it is unclear whether this translates to similar patterns of GP consultations for MUPS between parents and children. This study found evidence of an association between GP consultations for MUPS in parents and their children. GPs need to be aware of this link, which has implications for the management and prevention of MUPS among children in primary care.
studies was appraised using a methodological quality-assessment checklist for observational studies. This checklist consists of 15 items covering internal and external validity (see Appendix 1). The methodological quality for each paper was assessed independently by two reviewers. Each study was scored according to its methodological quality, using the 15-item checklist. Each item was scored positive (+) if it was satisfactorily presented, negative (−) if absent, or (na) if it was not applicable. Some items were not applicable, because of study design (no losses or dropouts in cross-sectional studies and medical record reviews). The overall methodological quality of each study was rated as ‘high’ if all or most of the items were fulfilled, ‘moderate’ if some of the items were fulfilled, and ‘low’ if few or no items were fulfilled.

RESULTS
Studies identified
A total of 2256 papers were identified (1106 MEDLINE, 745 Embase, 113 CINAHL, and 292 PsycINFO). Of those papers, only eight were included in the review (Figure 1).

Quality assessment
The overall methodological qualities of included studies were high. The following items were attained by all studies: clearly defined objective, appropriate study design, representative sample, appropriate selection of outcome, appropriate measurement of outcome, standardised data collection, appropriate analysis of outcomes, and numerical description of important outcomes (Table 1).

Characteristics of included studies
Study characteristics are presented in Table 2. Included studies were published in English and were conducted in four different countries. Six studies were conducted in primary care and two studies identified children from schools. There

| Table 1. Quality assessment of included studies |
|-----------------------------------------------|
| Study                                      | Quality-assessment items | Overall Quality |
|---------------------------------------------|--------------------------|-----------------|
| Balague et al, 1995                       | + + + + − + + + na na + + + | High           |
| Balague et al, 1994                       | + + + − + + na + na + + + | High           |
| Campo et al, 2007                         | + + + − + + + na na + + + | High           |
| Cardol et al, 2006                        | + + + + + + + na na na + + + | High           |
| Craig et al, 2002                         | + + + − + + + na na + + + | High           |
| Levy et al, 2004                          | + + + − + + + na na + + + | High           |
| Levy et al, 2000                          | + + + + + + + na + + + + + | High           |
| Little et al, 2001                        | + + + + + + + + + + + + | High           |

+ = satisfactorily presented. − = absent. na = not applicable. *See Appendix 1 for detailed description of quality-assessment items.*

| Table 2. Characteristics of included studies |
|---------------------------------------------|
| Study                                      | Country     | Setting | Design              | Children’s age, years | Sex, % females | Sample size | Physical symptoms | Data source                                                                 |
|---------------------------------------------|-------------|---------|---------------------|-----------------------|----------------|-------------|-------------------|--------------------------------------------------------------------------------|
| Balague et al, 1995                        | Switzerland| School  | Cross-sectional     | 12–17                 | 52.5           | 615         | NLBP              | History of NLBP in parent and children was reported by children               |
| Balague et al, 1994                        | Switzerland| School  | Cross-sectional     | 8–16                  | 50.6           | 1716        | NLBP              | History for NLBP in parent and children was reported by children aged 13–16 years, and by parents for younger children |
| Campo et al, 2007                          | US          | Primary care | Case-control cohort | 8–15                  | 48.5           | 136         | FAP               | History of MUPS in mothers and FAP in children was reported by mothers          |
| Cardol et al, 2006                         | The Netherlands | Primary care | Retrospective cohort | 1–12                  | 60             | 6571        | MUPS              | Medical records review for parents and children                                 |
| Craig et al, 2002                          | UK          | Primary care | Cross-sectional     | 4–8                   | 52             | 151         | MUPS              | Medical records review for mothers; mothers reported on MUPS and GP consultations in children |
| Levy et al, 2004                           | US          | Primary care | Case-control cohort | 8–15                  | 51             | 641         | MUPS              | Medical records review for maternal IBS and FAP and for MUPS in the child, plus self-report data on MUPS in the child by mother |
| Levy et al, 2000                           | US          | Primary care | Case-control cohort | 3–14                  | 49             | 1277        | GI symptoms       | Medical records review for parents and children                                 |
| Little et al, 2001                         | UK          | Primary care | Cross-sectional     | <16                   | 50             | 456         | MUPS              | History of GP consultations for MUPS in parents and children was reported by parents |

FAP = functional abdominal pain. GI = gastrointestinal. IBS = irritable bowel syndrome. MUPS = medically unexplained physical symptoms. NLBP = non-specific low back pain.
were four cross-sectional surveys, three case-control studies, and one retrospective cohort study. In four studies, the parent or the child reported information on MUPS and GP consultations, and the remaining studies used either medical records alone or medical records combined with self-reported data. The mean age of children ranged between 8.5 and 14 years. The mean proportion of females was 52% (range 49% to 60%).

Association of GP consultations for MUPS between parents and children
Table 3 presents the associations of GP consultations for MUPS between parents and children. Six studies found significant associations between GP consultations for MUPS, history of treated NLBP or IBS in parents, and GP consultations for MUPS in children (Table 3).\(^{22,23,27,29,31-36}\) Four studies reported the strength of associations as adjusted odds ratios (ORs) with 95% confidence intervals (CIs), and two studies used adjusted P-values. Two studies did not report the strength of association, but stated that it was not significant.

One study \((n = 456)\) found a significant association between self-reported GP consultations for MUPS in parents and children \((OR = 1.36, 95\% CI = 1.10 \text{ to } 1.70)\).\(^{23}\) Another study \((n = 151)\) showed a significant association between somatisation disorder in mothers and maternal reports of GP consultations for MUPS in children \((\text{adjusted } P<0.001)\).\(^{34}\) Three studies looked at IBS; one reported significant associations between IBS in parents and recorded GP consultations for GI symptoms in 1277 children \((OR = 2.2, 95\% CI = 1.62 \text{ to } 2.98)\),\(^{34}\) and another between IBS in mothers and recorded GP consultations for GI and non-GI symptoms in 641 children \((\text{adjusted } P = 0.006 \text{ and } 0.001, \text{ respectively})\). One study \((n = 135)\) showed no significant association between history of IBS, migraine, and somatoform disorder in mothers and maternal reports of GP consultations for FAP in children \((\text{OR was reported as not significant})\).\(^{35}\) Two studies investigated the association of reported history of treated NLBP in parents and history of NLBP in children; one study \((n = 1716)\) showed a significant association \((OR = 2.10, 95\% CI = 1.56 \text{ to } 2.80)\),\(^{35}\) whereas the other study \((n = 615)\) found no significant association \((\text{OR was reported as not significant})\).\(^{27}\) The final study \((n = 65 \text{ to } 671)\) reported the percentage of variance in similarity of recorded GP consultations among family members explained by family influence.\(^{35}\) For example, the variation in GP consultations by mothers and daughters that could be explained by family influence was 48.4% for headache and 34.7% for abdominal pain (Table 3).

Owing to the high degree of study heterogeneity between studies, pooled estimates of the strength of associations were not performed.

**DISCUSSION**

Summary
This review provides evidence that GP consultations for MUPS in parents are associated with GP consultations for MUPS in children. The review included eight papers, of which six found significant associations between GP consultations for MUPS in parents and children. Differences between studies in study designs, settings, data-collection methods, ages and numbers of included children, and types of included MUPS may partly explain the lack of association found in two studies. For example, these two studies examined the association between the lifetime prevalence of reported NLBP in children and history of treated NLBP in parents, and reported mixed findings. In the first study,\(^{29}\) schoolchildren reported information on their lifetime prevalence of NLBP as well as the history of treated NLBP in parents, whereas in the other study,\(^{27}\) both parents and children reported information on the history of their NLBP. Therefore, a possible lack of children’s knowledge of their parents’ history of treated NLBP, or recall bias, may partially explain the contradictory findings of these two studies.

The mechanisms underlying the association of GP consultations for MUPS between parents and children are not fully clear. However, there is some evidence that genetic effects,\(^{27,38}\) shared environmental factors,\(^{29,40}\) and childhood social learning of illness behaviour\(^{24,36,41,42}\) may explain this association. Although the majority of studies controlled for some possible confounding factors, it has been suggested that a parental decision to seek health care for their children may reflect parental health attitudes, health beliefs, and consulting behaviour, rather than the child healthcare needs.\(^{27,36,38}\) Therefore, the association of GP consultations for MUPS in parents and children may be explained by biased parental perception of symptoms in children or parental concentration on the symptoms they have themselves. For example, in one study, children with GI symptoms were interviewed independently of their mothers with IBS, and it was found that the difference between children of
Table 3. Associations of GP consultations for MUPS between parents and their children

| Study                  | MUPS                        | Time period | Summary of association                                                                 | Factors adjusted for in multivariable analyses                                                                 | Strength of association                      |
|------------------------|-----------------------------|-------------|----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| Balague et al, 1995    | NLBP in children and parents| Lifetime    | No significant association was found between parental reported history of treated NLBP and children’s lifetime history of NLBP | Child sex, age, walk time, sports activity, negative affect, positive affect, siblings’ LBP | Crude OR = 1.09, 95% CI was not reported; adjusted OR was not reported |
| Balague et al, 1994    | NLBP in children and parents| Lifetime    | Children of parents who had been treated for NLBP were more likely to report a history of NLBP themselves | Child age, sex, competitive sports activity, TV watched [hours/week] | Crude OR = 1.87, 95% CI = 1.42 to 2.48; adjusted OR = 2.10, 95% CI = 1.56 to 2.83 |
| Campo et al, 2007      | Children consulting with FAP and maternal MUPS | Lifetime | No significant association was found between child GP consultations for FAP and maternal MUPS | Maternal age, maternal psychiatric (anxiety and depressive) disorders, and family intact (child lives with biological parents) | For IBS: crude OR = 3.9, 95% CI = 1.5 to 10.3; adjusted OR = 1.8, 95% CI = 0.6 to 6.1; for migraine: crude OR = 2.4, 95% CI = 1.1 to 5.3, adjusted OR = 1.4, 95% CI = 0.6 to 3.7 |
| Cardol et al, 2006     | MUPS in children and parents| 1 year      | There was an association in GP consultation frequency for headache and abdominal pain between children and their parents compared to other families in which children consulted for physical trauma or chronic disease; association was reported as percentage of shared variance in consultation frequency between families | Child age and sex and GP practice | Percentage of variation in consultation frequency attributed to shared family factors (95% CI). |

| Family members | Headache | Abdominal pain | Minor ailments |
|----------------|----------|----------------|----------------|
| Mother/son     | 20.2 (16.4 to 24.1) | 34.1 (31.0 to 37.1) | 19 (18.0 to 20.0) |
| Mother/daughter| 48.4 (44.5 to 52.3) | 34.7 (31.7 to 37.7) | 23.2 (22.1 to 24.3) |
| Father/son     | 4.7 (2.7 to 7.2) | 17.1 (14.4 to 20.0) | 8.8 (8.0 to 9.7) |
| Father/daughter| 14.4 (11.1 to 18.1) | 6.9 (5.1 to 8.9) | 4.9 (4.3 to 5.6) |

Craig et al, 2002; Levy et al, 2004; Levy et al, 2000; Little et al, 2001

FAP = functional abdominal pain. GI = gastrointestinal. IBS = irritable bowel syndrome. LBP = lower back pain. MUPS = medically unexplained physical symptoms. NLBP = non-specific low back pain. OR = odds ratio.
cases and controls was greater when the mothers reported on symptoms in children compared to children’s reports on their own symptoms.\textsuperscript{21} Also, the observed association of GP consultations for MUPS between parents and children may perhaps just reflect patterns of GP consultations more generally.

**Strengths and limitations**

This review included only eight studies. This was despite a comprehensive search covering several electronic bibliographic databases. The citations of all included studies were searched, and no further relevant studies were identified. One relevant paper was identified through searching the references lists of included studies. The search did not address all sources of grey literature. However, local experts were contacted to identify any relevant studies, and the search was not restricted to English language publications. No studies were excluded from the review on the basis of quality assessment.

In addition to the high degree of heterogeneity among included studies, there are some limitations that should be considered when interpreting the results of this review. First, the majority of included studies relied on self-reported data, which are prone to recall bias. However, two studies examined agreement between self-reported and documented consultation for MUPS, and they showed good agreement.\textsuperscript{22,24}

Second, four studies used self-reported data on the history of IBS or treated MUPS rather than patterns of GP consultations for these conditions. However, it is reasonable to suggest that those parents had to consult a medical practitioner to receive treatment and diagnosis for those conditions. Third, owing to the small number of included studies, publication bias was not assessed. Therefore, the potential for publication bias remains.

Fourth, although all studies were generally of high methodological quality, only two reported a priori calculation of sample size. Finally, four studies were cross-sectional and were therefore unable to distinguish the direction of associations.

**Comparison with existing literature**

This is the first systematic review to summarise the research evidence on the association of GP consultations for MUPS between parents and children. The findings from this review are in agreement with findings of other studies that specifically focused on the association of self-reported MUPS (without including GP consultations data) between parents and children, which showed mixed results.\textsuperscript{21,26,31,32}\textsuperscript{43} For example, two studies reported significant associations for self-reported history of FAP between parents and children,\textsuperscript{21,22} whereas this association was found to be non significant in another study.\textsuperscript{24}

**Implications for practice**

The potential impact of parental GP consultations for MUPS on the health and GP consultations of their children has implications for primary care. It is important that GPs be aware of this link, as such insights may direct the GP toward alternative management approaches. For example, cognitive behavioural therapy (CBT) targeting children’s coping responses to FAP and parents’ responses to pain in their children was associated with significant reduction in pain and MUPS severity in children in the CBT group compared to a control group.\textsuperscript{44} Another study showed that CBT for children with persistent MUPS and anxiety was associated with significant improvements in anxiety symptoms and reduction in pain severity and discomfort due to GI symptoms, as compared to controls.\textsuperscript{45}

This review provides some evidence of an association between GP consultations for MUPS in parents and children. There are a limited number of studies that have investigated the association of GP consultations for MUPS between parents and children. Further longitudinal research, without relying on retrospective recall of physical symptom experience, is needed to further investigate the association between GP consultations for MUPS among parents and children. Future studies may wish to investigate this association by focusing on the whole spectrum of MUPS, including different age groups of children. Such research may provide more precise measures of the impact of parental MUPS on the health and GP consultations of their children, which has implications for the management and prevention of physical symptoms.

---

**Funding**

Mujahed Shraim is funded by NHS Research and Development Support for New Medical Schools. Kate M Dunn is funded through a Research Career Development Fellowship from the Wellcome Trust (083572). Christian D Mallen is funded by a Clinician Scientist Fellowship (19634) from Arthritis Research UK.

**Ethical approval**

Ethical approval was not required.

**Provenance**

Freely submitted; externally peer reviewed.

**Competing interests**

The authors have declared no competing interests.

**Discuss this article**

Contribute and read comments about this article on the Discussion Forum: http://www.rcgp.org.uk/bjgp-discuss
REFERENCES

1. Jordan KP, Kadat UM, Hayward R, et al. Annual consultation prevalence of regional musculoskeletal problems in primary care: an observational study. BMC Musculoskeletal Disord 2010; 11: 144.

2. Latinovic R, Guilford M, Ridsdale L. Headache and migraine in primary care: Consultation, prescription, and referral rates in a large population. J Neurol Neurosurg Psychiatry 2006; 77(3): 385–387.

3. Nimnuan C, Hotopf M, Wessely S. Medically unexplained symptoms: An epidemiological study in seven specialties. J Psychosom Res 2001; 51(1): 361–367.

4. Melville DI. Descriptive clinical research and medically unexplained physical symptoms. J Psychosom Res 1987; 31(3): 359–365.

5. Kosenke K, Jackson JL. Outcome in general medical patients presenting with common symptoms: a prospective study with a 2-week and a 3-month follow-up. Fam Pract 1999; 15(3): 398–403.

6. Jackson JL, Passamonti ML. Symptoms in primary care: outcomes at five years. J Gen Intern Med 2001; 16(1): suppl. 142.

7. El-Metwally A, Salminen JJ, Axelin A, et al. Prognosis of non-specific musculoskeletal pain in preadolescents: a prospective 4-year follow-up study till adolescence. Pain 2004; 108(3): 550–559.

8. Pergolizzi JW, Hunfeld JA, Hazebrook-Kampschreur AA, et al. The natural course of chronic benign pain in childhood and adolescence: a two-year population-based follow-up study. Eur J Pain 2003; 7(6): 551–559.

9. Hotopf M, Carr S, Mayou R, et al. Why do children have chronic abdominal pain, and what happens to them when they grow up? Population based cohort study. BMJ 1999; 316(7139): 1176–1200.

10. Gold JI, Mahrer NE, Yee J, Palermo TM. Pain, fatigue, and health-related quality of life among children and adolescents. Pain 2004; 110(3): 283–293.

11. Roth-Isigkeit A, Thyen U, Stoven H, et al. Pain among children and adolescents: restrictions in daily living and triggering factors. Pediatrics 2005; 115(2): e152–162.

12. Hunfeld JA, Perquin CW, Hazebrook-Kampschreur AA, et al. Physically unexplained chronic pain and its impact on children and their families: the mother’s perception. Psychol Psychother 2002; 75(pt 3): 251–260.

13. Mallen CD, Peat G, Thomas E, et al. Prognostic factors for musculoskeletal pain in primary care: a systematic review. Br J Gen Pract 2007; 57(541): 565–566.

14. Campo JV. Functional abdominal pain in childhood: lifetime and familial associations with irritable bowel syndrome and psychiatric disorders. Prim Psychiatry 2007; 14(4): 64–68.

15. Berntsson LT, Gustafsson JE. Determinants of psychosomatic complaints in Swedish schoolchildren aged seven to twelve years. Scand J Publ Health 2000; 28(4): 285–293.

16. Emmison M, Benjamin S, Shortall A, et al. Physical symptoms and illness attitudes in adolescents: an epidemiological study. J Child Psychol Psychiatry 1996; 37(5): 519–528.

17. Saps M, Shohadri R, Saitanberg M, et al. A prospective school-based study of abdominal pain and other common somatic complaints in children. J Pediatr 2009; 154(3): 322–326.

18. Egger HL, Costello EJ, Erkanli A, Angold A. Somatic complaints and psychopathology in children and adolescents: stomach aches, musculoskeletal pains, and headaches. J Am Acad Child Adolesc Psychiatry 1999; 38(7): 852–860.

19. Fiddler M, Jackson J, Kapur N, et al. Children’s adversity and frequent medical consultation. Gen Hosp Psychiatry 2004; 26(5): 367–377.

20. Goodwin RD, Hoven CW, Murison R, Hotopf M. Association between childhood physical abuse and gastrointestinal disorders and migraine in adulthood. Am J Public Health 2003; 93(7): 1065–1067.

21. Virtanen R, Aronen M, Koskenvuo M, et al. Prevalence and incidence of headache in adolescent Finnish twins. Headache 2009; 49(10): 1503–1512.

22. Little P, Somerville J, Williamson I, et al. Family influences in a cross-sectional survey of higher child attendance. Br J Gen Pract 2001; 51(473): 977–981, 984.

23. Levy RL, Whitehead WE, Walker LS, et al. Increased somatic complaints and health-care utilization in children: effects of parent IBS status and parent response to gastrointestinal symptoms. Am J Gastroenterol 2004; 99(12): 2442–2451.

24. Craig T, Axon AD, Klein K. Intergenerational transmission of somatization behaviour: a study of chronic somatizers and their children. Psychol Med 2002; 32(5): 805–816.

25. Jones DT, Silman AJ, Macfarlane GJ. Parental pain is not associated with pain in the child: a population based study. Ann Rheum Dis 2004; 63(9): 1152–1154.

26. Huang RC, Palmer LJ, Forbes DA. Prevalence and pattern of childhood abdominal pain in an Australian general practice. J Paediatr Child Health 2000; 36(4): 349–353.

27. Balague F, Skovron ML, Nordin M, et al. Low back pain in schoolchildren. A study of familial and psychological factors. Spine (Phila Pa 1976) 1995; 20(11): 1216–1270.

28. Saunders K, Korf MV, Leresche L, Manci L. Relationship of common pain conditions in mothers and children. Clin J Pain 2007; 23(3): 204–213.

29. Balague F, Nordin M, Skovron ML, et al. Non-specific low back pain among schoolchildren: a field survey with analysis of some associated factors. J Spinal Disord 1994; 7(4): 374–379.

30. Salminen JJ. The adolescent back. A field survey of 370 Finnish schoolchildren. Acta Paediatr Scand Suppl 1984; 315: 1–122.

31. Devanarayana NM, de Silva DG, de Silva HJ. Recurrent abdominal pain syndrome in a cohort of Sri Lankan children and adolescents. J Trop Pediatr 2008; 54(3): 178–183.

32. Booy CC, Geh KL. Predictors of recurrent abdominal pain among 9 to 15-year-old urban school-children in Malaysia. Acta Paediatr 2001; 90(3): 353–355.

33. Mallen CD, Peat G, Thomas E, et al. Prognostic factors for musculoskeletal pain in primary care: a systematic review. Br J Gen Pract 2007; 57(541): 605–611.

34. Campo JV, Bridge J, Lucas A, et al. Physical and emotional health of mothers of children with functional abdominal pain. Arch Pediatr Adolesc Med 2007; 161(2): 131–137.

35. Cardol M, van den Bosch WJ, Spreuwenberg P, et al. All in the family: headaches and abdominal pain as indicators for consultation patterns in families. Ann Fam Med 2006; 4(6): 506–511.

36. Levy RL, Whitehead WE, Von Korff MR, Feld AD. Intergenerational transmission of gastrointestinal illness behavior. Am J Gastroenterol 2000; 95(3): 451–456.

37. Larsson B, Bille B, Pedersen NL. Genetic influence in headaches: a Swedish twin study. Headache, 1995; 35(9): 513–519.

38. Morris-Yates A, Talley NJ, Boyd PM, et al. Evidence of a genetic contribution to functional bowel disorder. Am J Gastroenterol 1998; 93(8): 1311–1317.

39. Huurre T, Junkkari H, Aro H. Long-term psychosocial effects of parental divorce: a follow-up study from adolescence to adulthood. Eur Arch Psychiatry Clin Neurosci 2006; 256(4): 256–263.

40. Troxel WM, Matthews KA. What are the costs of marital conflict and dissolution to children’s physical health? Clin Child Fam Psychol Rev 2004; 7(1): 29–57.

41. Levy RL, Langer SL, Whitehead WE. Social learning contributions to the etiology and treatment of functional abdominal pain and inflammatory bowel disease in children and adults. World J Gastroenterol 2007; 13(17): 2397–2403.

42. Cardol M, van Dijk L, van den Bosch WJ, et al. Striking variations in consultation rates with general practice reveal family influence. BMC Fam Pract 2007; 8: 4.

43. Kashikar-Zuck S, Lynch AM, Slater S, et al. Family factors, emotional functioning, and functional impairment in juvenile fibromyalgia syndrome. Arthritis Rheum 2008; 59(10): 1392–1398.

44. Levy RL, Langer SL, Walker LS, et al. Cognitive-behavioral therapy for children with functional abdominal pain and their parents decreases pain and other symptoms. Am J Gastroenterol 2010; 105(4): 746–756.

45. Warner CM, Colognori D, Kim RE, et al. Cognitive-behavioral treatment of persistent functional somatic complaints and pediatric anxiety: an initial controlled trial. Depress Anxiety 2011; 28(7): 551–559.
### Appendix 1. Items used to assess the quality of observational studies

|   | Description                                                                                           |
|---|-------------------------------------------------------------------------------------------------------|
| A | Clearly defined study objective                                                                     |
| B | Appropriate design for study question                                                                |
| C | Inclusion and exclusion criteria clear and appropriate                                               |
| D | Representative sample (and comparison)                                                                |
| E | Sample size calculation presented                                                                      |
| F | Appropriate selection of outcome                                                                       |
| G | Appropriate measurement of outcome                                                                    |
| H | Standardised collection of data                                                                        |
| I | Adequate length of follow-up for research question                                                     |
| J | Baseline participation >70% (all groups)                                                              |
| K | Losses and dropouts <20%                                                                             |
| L | Adequate description of losses and completers                                                         |
| M | Appropriate analysis of outcomes measured                                                             |
| N | Numerical description of important outcomes given                                                    |
| O | Adjusted and unadjusted calculations provided (with confidence interval if appropriate)               |