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Health Anxiety in Preadolescence - Associated Health Problems, Healthcare Expenditure, and Continuity in Childhood

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Abstract Epidemiological data on the distribution, persistence, and clinical correlates of health anxiety (HA) in childhood are scarce. We investigated continuity of HA symptoms and associated health problems and medical costs in primary health services in a general population birth cohort. HA symptoms were assessed in 1886 Danish 11–12 year old children (48 % boys) from the Copenhagen Child Cohort using the Childhood Illness Attitude Scales (CIAS) together with information on socio-demographics and the child's somatic and mental status and healthcare expenditure. Non-parametric statistics and regression analysis were used to compare groups with low (n=184), intermediate (n=1539), and high (n=161) HA symptom scores. The association between HA symptoms assessed at age 5–7 years and HA symptoms at ages 11–12 years was examined by Stuart-Maxwell test. HA symptoms were significantly associated with emotional disorders and unspecific somatic complaints, but not with chronic physical conditions. In regression analyses controlling for gender and physical comorbidity, healthcare expenditure peaked in children with the highest HA symptom score, that is these children used on average approximately 150 Euro more than children with the lowest score during the 2-year period preceding inclusion. HA symptoms at age 5–7 years were significantly associated with HA symptoms at age 11–12 years. We conclude that HA symptoms, including hypochondriacal fears and beliefs, were non-trivial in preadolescents; they showed continuity from early childhood and association with emotional disorders, unspecific somatic complaints, and increased healthcare expenditure. Further research in the clinical significance of childhood HA is required.

Keywords Hypochondriasis · Health Anxiety · Childhood Illness Attitude Scales · Child · Epidemiology

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Health anxiety (HA) is a broad diagnostic construct encompassing excessive health and illness worries that extend from mild to severe forms with ICD-10- and the former DSM-IV-defined 'hypochondriasis' at the extreme clinical endpoint (Asmundson et al. 2010; Creed and Barsky 2004). Severe HA is characterized by core cognitive, somatic and behavioral features (Asmundson et al. 2010; Barsky et al. 2001; Fink et al. 2004; Rachman 2012). The core cognitive feature is obsessive rumination with thoughts about suffering from a disease where benign bodily sensations and changes are misinterpreted as signs of disease processes. In response, maladaptive coping behaviors often develop with frequent checking of the body and of medical references and with repeated contacts to doctors to reassure the health status which may only perpetuate the dysfunctional beliefs and be detrimental in the long term. In the adult population, 1–3 % suffer from severe HA which entails disability, high health care costs, and a generally poor outcome with a recovery rate below 50 % (Fink et al. 2010; Olde Hartman et al. 2009; Sunderland et al. 2013). HA has been found to be equally frequent among men and women and without association with educational level or socioeconomic factors (Creed and Barsky 2004; Fink et al. 2004; Looper and Kirmayer 2001; Martin and Jacobi 2006).

The literature often describes HA as uncommon in children (Schulte and Petermann 2011) with onset primarily in adulthood (American Psychiatric Association 2000). The prevalence of hypochondriasis in younger age groups has been studied in very few studies which have found that none or only a few children and adolescents meet the diagnostic criteria for the disorder (Bisht et al. 2008; Essau 2007; Lieb et al. 2000). However, this low prevalence in children may mainly be explained by the lack of specific, developmentally appropriate diagnostic criteria targeting children and adolescents (Fritz et al. 1997). Retrospective studies on adults with hypochondriasis indicate that HA precursors are present already during childhood (Fink et al. 2004; Noyes et al. 2002) and studies exploring symptoms rather than the full hypochondriasis disorder suggest that excessive HA can be present in younger age groups. A former study (Eminson et al. 1996) examined illness attitudes in 11–16 year-old adolescents using a slightly modified version of the Illness Attitude Scales (IAS), which currently is the gold standard for self-rated HA symptoms in adults (Sirri et al. 2008). The measure includes nine three-item subscales: worry about illness; concern about pain; health habits; hypochodriacal beliefs; thanatophobia (i.e., abnormal fear of death), disease phobia, bodily preoccupation, treatment of experience, and effects of symptoms. Participants who endorsed an elevated number of physical symptoms also scored significantly higher on seven of the IAS subscales. These observations were supported in the later study on school children by Wright and Asmundson (2003) who developed and tested the Childhood Illness Attitude Scales (CIAS), a modified version of the IAS to be used for children aged 8–15 years. The adaptations included language simplification, a simplified rating scale, and seven additional items to evaluate child help-seeking behavior from parents with regard to medical attention or treatment. Finally, in a former study on the Copenhagen Child Cohort, CCC2000, we assessed parental-reported HA symptoms in a large sample of 5–7 year old children and found positive association between the severity of the child's HA symptoms and the degree of health problems, including functional or medically unexplained somatic symptoms and internalizing disorders (Rask et al. 2012). Together these studies seem to demonstrate fears, beliefs, and attitudes in youth with similarities to cognitive and behavioral features of HA in adults.

The current longitudinal study aimed to expand the limited knowledge on HA in children by exploring the distribution, health associates, and costs of HA symptoms, and their continuity from early childhood to preadolescence in a non-clinical sample. Specifically, we wished to investigate whether 11–12 year old children with a high HA score on the CIAS also had more a) somatic morbidity measured by chronic physical disorders, deranged BMI (under- or overweight) and unspecific somatic complaints; b) concurrent mental problems, especially emotional disorders; and c) higher health care expenditures 2 years prior to HA assessment than children with lower HA scores. We hypothesized that presence of HA symptoms in 5–7 year-old children predicted presence of these symptoms also at the age of 11–12 years. Drawing on the adult HA research we also expected to find an equal distribution of HA symptoms between boys and girls and no association between child HA symptoms and socio-demographic factors indexed by maternal education and household income.

Method

Participants

This study is part of a longitudinal, prospective study, the Copenhagen Child Cohort 2000 (CCC2000) (Skovgaard et al. 2005) which comprises 6090 children born in the county of Copenhagen in the year 2000. Data collection was performed in the 11–12 year follow-up conducted from 1 May 2011 until 1 October 2012. Cohort-members were traced through the Danish Civil Registration System where all citizens in Denmark have a unique 10-digit identification (ID) number that is stored with information on place of residence and ID numbers of parents (Schmidt et al. 2014). In total 4847 children were identified as eligible; 1243 were lost to follow-up (19 dead, 217 emigrated, 14 not traceable, and 993 had claimed research protection (an option that allows a citizen to avoid inquiries from research and consumer surveys)). Eligible children and their parents were invited by letter to

participate by completing web-based questionnaires and to sign up for a face-to-face assessment which included a physical examination with measurement of the child's height and weight.

Measures

Health Anxiety Symptoms HA symptoms at child age 11–12 years were assessed by The Childhood Illness Attitude Scales (CIAS). It is a 35-item self-report measure evaluating fears, beliefs, and attitudes associated with HA and abnormal illness behaviors in school-age children (Wright and Asmundson 2003). The standard measure has no time focus and most items are rated on a 3-point rating scale (1=*none of the time,* 2=*sometimes*, 3=*a lot of the time*). Items 29 through 31 are rated on a 3-point scale designed to evaluate the frequency of various treatment experiences (1=*zero times*, 2=*one or two times*, 3=*three or more times*). Items 28 and 32 are open-ended and provide supplementary information that is not used for scoring. The total score thus rests on 33 items (score range 33–99). The CIAS has shown high test-retest (10–14 days) reliability, r=0.86, and a high internal consistency, α=0.88, as well as significant associations between CIAS total scores and measures of similar constructs like childhood anxiety sensitivity (Wright and Asmundson 2003; Wright and Asmundson 2005). For the present study, with permission of the authors, the CIAS was translated to Danish using the back-translation strategy for cross-cultural research. Two bilingual translators performed forward translations independently and both versions were subsequently conciliated and incorporated into a common Danish version by an expert panel (child and adolescent psychiatrists with their research area in this field) using a consensus procedure. Back translation was carried out by a professional translator with understanding of Danish but with no knowledge of the CIAS or access to the original version in English. The back translated version was approved by the authors of CIAS. Prior to the main study the Danish version was pilot-tested which confirmed its face validity. The internal consistency in the present study was good, α=0.80.

For the longitudinal study, we added data from the 5–7 year follow-up of the CCC2000 (Rask et al. 2012). In this study wave, parent-reported HA symptoms in the children were obtained by the Soma Assessment Interview (SAI) (Rask et al. 2009). The SAI includes three items intended to reflect characteristic cognitive and behavioral features of adult HA but constructed in an age appropriate manner for young children. The parents are asked: 1) Does your child tend to complain a lot about pain or somatic symptoms, when there isn't much wrong with him/her?, 2) Does your child worry a lot about his/her health?, and 3) It is hard to calm down or divert your child when she/he has somatic complaint(s) or is worried about his/her health? Possible response categories are: *No, Yes, a little* or *Yes, a lot*. In a former study, we pilot-tested these items twice. First on 58 parents of 5–6 year-old children with no health problems or with different psychiatric and/or somatic problems, respectively, and subsequently, after minor revisions, on 10 new parents. The results confirmed good face validity which was further supported by a confirmative factor analysis showing all three items to tap into the same construct (Rask et al. 2012). In the present study, HA symptom presence was defined as a positive response to a least one of the three items; considerable symptoms were defined as the response *Yes, a lot* to at least one of the three items.

Socio-Demographic Characteristics Information was obtained from Danish national registers: the Integrated Database for Labor Market Research (parents' immigrant status, annual household income, change in family composition, maternal education) and the Medical Birth Register (maternal age) by linkage through the Danish Civil Registration System using the personal ID numbers of the CCC2000 children (Schmidt et al. 2014).

Somatic Health Problems The Children's Somatization Inventory, Child Report Form, revised (CSI-24) (Walker et al. 2009) was used to assess the child's perceived severity of various unspecific somatic symptoms, including headaches, low energy, dizziness, and chest pain during the past 2 weeks. The response format is a 5-point scale ranging from 0=*not at all* to 4=*a whole lot* (total scores range 0–96). The CSI-24 has shown good psychometric properties (Walker et al. 2009). The internal consistency in the present study was α=0.83. Chronic physical conditions were assessed by a predefined list asking parents to report if their child suffered from any chronic physical disease diagnosed by a doctor (e.g., cardiac disease, diabetes, asthma, epilepsy). Difficulties managing weight can be viewed as a potential somatic health problem. In accordance with this the Body Mass Index (BMI) was used as an indicator of somatic problems. It was calculated based on the child's weight and height data and classified using the International Obesity Task Force (IOTF) BMI cut-off points for underweight (BMI<18.5), normal weight (18.5≤BMI≤25), and obesity (BMI>25) in children (Cole et al. 2007).

Mental Health Problems The Development and Well-Being Assessment (DAWBA) (Goodman et al. 2000) was used to assess mental disorders. It is a well-validated and comprehensive psychiatric interview, administered to parents and child, including a brief questionnaire for teachers. The structured questions cover operationalized DSM-IV criteria for several diagnostic categories such as pervasive developmental disorders, attention deficit/hyperactivity disorders, oppositional defiant/conduct disorders, anxiety disorders (including separation anxiety, social phobia, generalized anxiety, specific phobia, panic disorder/agoraphobia, generalised anxiety disorder), post-traumatic stress disorder (PTSD), depressive

disorders, obsessive-compulsive disorder (OCD), psychosis and tics. Open-ended questions record the respondent's own description of problems. Experienced child and adolescent psychiatrists review all available information (e.g., results of the DAWBA diagnostic algorithm and children's and parents' descriptions of the child's problems). The clinician decides whether the child meets DSM-IV criteria for a specific mental disorder. In the present study, the joint inter-rater reliability between three senior raters for any DSM-IV disorder indexed by Cohen's Kappa was 0.81 (Jeppesen et al. 2015). The diagnoses were grouped into two major categories: emotional disorders (anxiety and depressive disorders, PTSD and OCD) and neurodevelopmental disorders (oppositional defiant/conduct disorder, attention-deficit/hyperactivity disorder, tics, psychosis, and pervasive developmental disorders).

Healthcare Expenditure The Danish healthcare system is almost entirely tax financed where, with few exceptions, all medical care is free of charge. We obtained information from the Danish National Health Service Register (Andersen et al. 2011) about the activities of health professionals contracted with the tax-funded public health care system, including general practitioners and practicing medical specialists. We included the total costs of primary sector medical care services (i.e., costs of contacts to doctors, lab tests, x-rays, etc.; calculated in Euro, adjusted to 2014 prices) for the 2-year period preceding study inclusion.

Ethical Standards

The study was approved by The Danish Data Protection Agency (J.nr. 2010-41-4438) and by the Capital Region of Denmark (J.nr. 2007-58-0015). The National Committee on Health Research Ethics was consulted (J.nr. H-C-FSP-2010) in order to ensure the study complied with ethical standards of the Danish national guidelines and with the Helsinki Declaration of 1975, as revised in 1983. Parents of participating children gave informed consent at both waves. This manuscript contains no information that discloses the identity of our participants or violates their privacy.

Data Analysis

Chi-squared tests were used for attrition analyses. Descriptive CIAS statistics was calculated for the whole sample as well as for boys and girls separately. Using a pragmatic approach, the total CIAS score was calculated only in cases with less than 13 score items missing out of 33. Missing values were replaced with *1*. Gender differences were examined by Student's *t*-test. Due to lack of established clinically relevant cut-points and assuming an approximately normal CIAS score distribution, we chose the 10 % and the 90 % percentiles to determine cut-off values for children with low degree of HA symptoms (CIAS score <10 % percentile), intermediate degree of HA symptoms (10 % percentile≤CIAS score≤90 % percentile), and high degree of HA symptoms (CIAS score>90 % percentile), respectively. Non-parametric tests were used to compare the subgroups with regard to socio-demographic characteristics and somatic and mental health problems. For the analyses on associated health care expenditures, we used bootstrap analyses to account for skewed data with subsequent estimation of sample means of costs for the 2 years preceding study inclusion and bias-corrected and accelerated (BCa) 95 % confidence intervals (CIs). Equality of costs means was tested in pairs between children with a low, intermediate, and high degree of HA symptoms, respectively, by computing the bootstrap test statistic achieved significance level (ASL) (Efron and Tibshirani 2003). Additional multiple regression analysis adjusting for gender and comorbidity with chronic physical conditions was performed with bootstrap estimates of variance based on 500 replications. The effect of level of HA symptoms was determined by Wald test. Continuity analysis (i.e., the association between parent-reported HA symptoms at child age 5–7 years and self-reported HA symptoms at child age 11–12 years) was performed by Stuart-Maxwell test accounting for paired data with ordered categorical data.

All statistical tests were two-sided. Owing to multiple comparisons a relative conservative criterion of $p<0.01$ was adopted for the analyses with non-parametric tests to control type I error. For other analyses a p-value<0.05 was considered significant. Data were processed in STATA version 13 (www.stata.com).

Results

Attrition

A total of 1886 children (39 % of 4847 eligible children) provided CIAS data (mean age=11.21 yrs; girls n=988, boys n=898) and a total CIAS score could be calculated for 1884. In total, 1558 (82.6 %) attended face-to-face assessment and had their BMI calculated.

Comparison between participants and non-participants alive at age 11 years showed lower frequency of low maternal age (≤ 20 year) (1.3 % vs. 4.8 %), low maternal education (< 11 year by 2010) (11.0 % vs. 21.7 %), change in family composition (22.5 % vs. 32.1 %), lowest increase in household income (26.1 % v. 33.6 %), and immigrated parents (1–2 parents) (19.8 % vs. 30.2 %) among participants; χ^2 tests, all p-values<0.01.

Distribution of Health Anxiety Symptoms

Table 1 shows descriptive statistics for the individual CIAS items. The percentage of participants rating *a lot* was lowest for CIAS items related to general illness worries (items 2, 22

Table 1 Descriptive statistics for CIAS items (n=1886)

Item	Response categories in %			
	None of the time (1)	*Some* (2)	*A lot* (3)	Missing
1. Do you worry about your health?	62.6	35.3	2.1	0
2. Are you worried that you might get really sick in the future?	74.7	24.4	0.9	0
3. Does the thought of being sick scare you?	76.8	21.9	1.3	0
4. If you have pain, do you worry that it may be caused by a bad sickness?	82.5	16.1	1.4	0
5. If pain lasts for a week or more, do you tell your mom or dad?	4.0	8.3	87.7	0
6. If pain lasts for a week or more, do you ask your mom or dad if you can go to the doctor?	30.8	31.5	37.7	0
7. If pain lasts for a week or more, do you believe that you have a bad sickness?	76.8	21.3	1.9	0
8. Do you try not to have habits that may be bad for you, such as smoking, drinking, or drugs?	42.5	1.5	56.0	0
9. Do you try not to eat foods that may not be good for you (such as junk food)?	36.7	41.8	21.4	0
10. Do you check your body to find out if there is something wrong?	75.0	22.4	2.6	0
11. Do you believe that you are really sick, but the doctors do not know why?	95.4	4.0	0.6	0.1
12. When you feel sick, do you tell your mom or dad?	2.7	11.4	85.9	0.1
13. When you feel sick, do you ask your mom or dad if you can go to the doctor?	37.3	35.6	27.1	0.1
14. Do you ask your mom or dad for medicine?	55.7	33.3	11.0	0.1
15. When your doctor tells you that you are not sick, do you not believe him/her?	25.1	10.7	64.2	0.1
16. If a doctor tells you what he/she found, do you soon begin to believe that you might have another sickness?	92.6	5.4	2.0	0.1
17. Are you afraid of news that reminds you of death?	64.8	28.1	7.1	0.1
18. Does the thought of dying scare you?	49.8	35.3	14.9	0.1
19. Are you afraid that you might die soon?	78.7	16.1	5.2	0.1
20. Are you afraid that you might have cancer?	86.9	10.1	3.0	0.1
21. Are you afraid that you have something wrong with your heart?	87.7	9.8	2.5	0.1
22. Are you afraid that you have another bad sickness?	95.8	4.2	0.0	0.1
23. When you read or hear about a sickness, do you think that you might have that sickness?	91.0	8.8	0.2	0.2
24. When you have a strange feeling in your body, do you find it hard to think about something else?	63.9	33.8	2.3	0.2
25. When you have a strange feeling in your body, do you worry about it?	56.9	40.6	2.5	0.2
26. When you have a strange feeling in your body, do you tell your mom or dad?	9.6	35.2	55.2	0.2
27. When you have a strange feeling in your body, do you ask your mom or dad if you can go to the doctor?	56.8	28.6	14.6	0.2
29. How many times have you seen your doctor in the last year?	29.5	53.2	17.3	0.2
30. How many doctors have you seen in the past year?	29.4	61.8	8.8	0.2
31. How often have you been treated (had to take medicine or had surgery) during the past year?	62.9	28.5	8.6	0.2
33. Do strange feelings in your body stop you from going to school?	81.2	18.2	0.6	0.3
34. Do strange feelings in your body stop you from enjoying yourself?	71.0	28.0	1.0	0.3
35. Do strange feelings in your body stop you from keeping your mind on what you are doing?	68.8	29.7	1.5	0.3

For item 29, 30, 31 the response categories are: 1=*0*, 2=*1–2*, 3=*3 or more*. Item 28 and 32 are open-ended questions and not used for analyses of the total CIAS score (range 33–99)

& 23), belief in the existence of a disease which physicians had failed to diagnose (item 11), and symptom impact on leisure and school activities (items 33, 34). The most frequently endorsed items were seeking help from parents when in pain (item 5) or feeling sick (item 12), for boys as well as for girls; however, boys tended generally to rate most items lower than girls, especially items concerning fear of death (item 17–19) (for details see the supplementary material, Online Resource S1).

The average CIAS score for all 1884 children was 51.92 (SD 7.17, range: 33–82); The total CIAS score differed significantly by gender, Students t-test: t(1882)=−5.48, p<0.001 (girls: 52.78 (SD=7.25, range: 34–82), boys: 50.90 (SD=6.96, range: 33–78)). The distribution resembled a normal curve for the whole sample as well as for boys and girls separately. The cut-off points for a low CIAS score (10 % percentile) was 44 and for a high CIAS score (90 % percentile) 62, meaning 184 children were categorized with a low, 1539

children with an intermediate, and 161 children with a high self-reported HA symptom score.

Socio-Demographic Characteristics

The three groups differed statistically significantly with regard to distribution of gender and ethnicity. The highest proportion of girls and families with immigrated parents was found in the subgroup of children reporting the highest CIAS scores (Table 2). The groups did not differ with respect to their families' socioeconomic status or the maternal age and educational level (Table 2).

Comorbidity with Somatic and Mental Health Problems

The proportion of children in the study sample with a least one parent-reported chronic physical condition during the past 12 months was 12.9 % (n=225) where asthma was the most frequently reported chronic condition (6.8 %). Weight problems can be another potentially somatic health problem;

Table 2 Socio-demographic characteristics, somatic and mental comorbidity in 11–12 year old children with low, intermediate, and high self-reported CIAS scores for HA symptoms (n=1884)

Characteristic	Low score 33≤x≤43 n=184	Intermediate score 44≤x≤62 n =1539	High score 63≤x≤99 n=161	Missing n	Test statistic
Socio-demograhics					
Gender, n (%)					
Female sex	76 (41.3)	812 (52.8)	99 (61.5)	0	$\chi^2(2)=14.50$, $p=0.001$(**)
No. of immigrated parents, n (%)					
0	146 (80.2)	1233 (81.2)	105 (66.5)		
1	17 (9.4)	152 (10.0)	26 (16.4)		
2	19 (10.4)	133 (8.8)	27 (17.1)	26	$\chi^2(4)=20.26$, $p<0.001$(***)
Maternal age at childbirth, n (%)					
16–20 years	4 (2.2)	16 (1.0)	5 (3.1)		
21–30 years	91 (49.5)	740 (48.2)	78 (48.8)		
31–40 years	88 (47.8)	756 (49.2)	74 (46.2)		
41–46 years	1 (0.5)	24 (1.6)	3 (1.9)	4	$\chi^2(6)=7.51$, $p=0.276$
Maternal education level, n (%)					
1–10 years	24 (13.2)	167 (11.0)	17 (10.7)		
11–14 years	81 (44.8)	747 (49.2)	78 (49.1)		
15+years	76 (42.0)	604 (39.8)	64 (40.2)	26	$\chi^2(4)=1.64$, $p=0.802$
Increase in family income 2000–2010, n (%)					
1. (lowest) tercile	45 (25.1)	397 (26.3)	49 (30.6)		
2. (middle) tercile	49 (27.4)	481 (31.9)	53 (33.1)		
3. (highest) tercile	85 (47.5)	630 (41.8)	58 (36.3)	37	$\chi^2(4)=4.89$, $p=0.299$
Mental health problems					
DSM-IV neurodevelopmental disorder, n (%)					
Yes	10 (5.4)	86 (5.6)	10 (6.2)	3	$\chi^2(2)=0.12$, $p=0.943$
DSM-IV emotional disorder, n (%)					
Yes	3 (1.6)	118 (7.7)	33 (20.5)	3	$\chi^2(2)=43.50$, $p<0.001$(***)
Somatic health problems					
Somatic condition, n (%)					
Yes	20 (11.8)	181 (12.6)	24 (17.1)	139	$\chi^2(2)=2.53$, $p=0.283$
Somatization (CSI24-score)					
Median (25, 75 percentiles)	2 (0, 4)	3 (1,7)	9 (5,18)	0	$\chi^2(2)=162.45$, $p<0.001$ (***)[a]
BMI[b], n (%)					
Underweight (BMI<18.5)	19 (12.6)	117 (9.2)	13 (9.9)		
Normal weight (18.5≤BMI≤25)	111 (73.5)	958 (75.1)	91 (68.9)		
Overweight (BMI>25)	21 (13.9)	200 (15.7)	28 (21.2)	326	$\chi^2(4)=5.02$, $p=0.285$

[a] Kruskal Wallis test

[b] BMI was only calculated on the 1558 children who also attended a face to face assessment

overweight (BMI>25) was seen in 16.1 % (n=260). Neither the proportion of chronic physical conditions nor weight problems differed significantly between the three groups scored according to CIAS level (Table 2). However, a high CIAS score was positively associated with a higher somatization score on the CSI-24 (i.e., self-reported unspecific somatic complaints during the past 2 weeks; median CSI-24 score: 9 vs. 3/2; χ^2 (2)=162.45, p<0.001).

The base rate of having a mental disorder in the total sample was 12.3 % (n=234). In separate analyses for emotional and neurodevelopmental disorders, a high CIAS score was strongly associated with emotional, but not with neurodevelopmental diagnoses (Table 2). Noteworthy, in 120 (74.5 %) of the 161 children with a high CIAS score, none of the DSM-IV disorders covered by the DAWBA were diagnosed.

Healthcare Expenditure

The average gross medical costs in the primary health sector 2 years prior to study inclusion (i.e., child age 9–10 years) were almost 150 Euro higher in the group with the highest CIAS score (mean: 309.98 Euro) than in the group with the lowest CIAS score (mean: 161.91 Euro), whereas the costs in the group with an intermediate score were largely in between (mean: 230.36 Euro) (Fig. 1).

The results of the paired comparisons showed that the costs were significantly higher in both subgroups with a higher CIAS score (i.e., intermediate and high) than in the subgroup with a low score; and healthcare expenditure also differed significantly between children with an intermediate and a high CIAS score (Fig. 1). In a second step, we conducted an analysis controlling for comorbid chronic physical condition and gender. Although the effect of comorbid physical condition, but not of gender, was highly significant, the HA group differences on healthcare expenditure remained significant, Wald test: χ^2 (2)=9.86, p<0.01.

Continuity of Health Anxiety Symptoms

Data on HA symptoms from both the 5–7 year follow-up and the 11–12 year follow-up were obtained for 801 children. Figure 2 shows the CIAS score distribution in the three groups with none, mild, and considerable parent-reported HA symptoms at age 5–7 years. None of the children with considerable HA symptoms early in life reported a low CIAS score at age 11–12 years. Paired analysis showed a highly significant association between parent-reported HA symptoms at child age 5–7 years and the self-reported HA symptoms at child age 11–12 years, Stuart-Maxwell test: χ^2(2)=555.55, p<0.0001.

Discussion

This first, large epidemiological investigation of childhood HA symptoms examined associated health features across a wide HA symptom spectrum in a general population-based cohort of 11–12 year old children. The results suggest that hypochondriacal fears and beliefs are common in preadolescents and may continue from early childhood. Significant associations between HA symptoms and mental health problems like emotional disorders and somatization were shown, but not between HA symptoms and well-defined somatic health

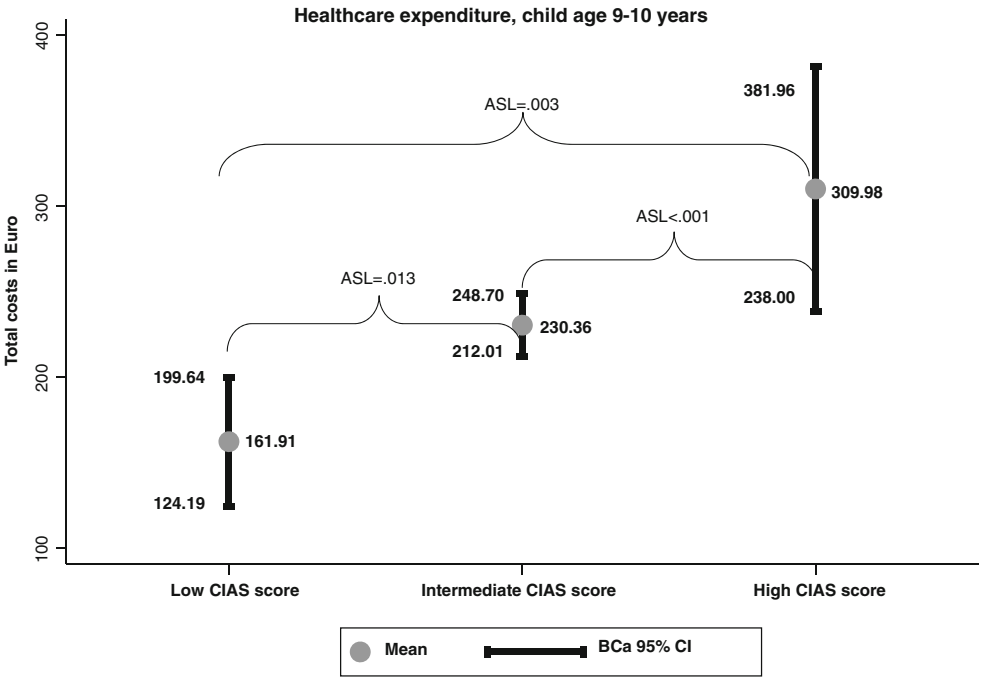

Fig. 1 Total costs in Euro for medical contacts (general practitioner and specialist doctors) in the primary health sector 2 years prior to assessment of HA symptoms at 11–12 years of age (expressed by CIAS scores). Test of equality of means in pairs was done by computing the bootstrap test statistic achieved significance level, *ASL* Achieved Significance Level, *BCa 95 % CI* Bias-Corrected and Accelerated 95 % Confidence Interval, *CIAS* Childhood Illness Attitude Scales, *HA* Health Anxiety

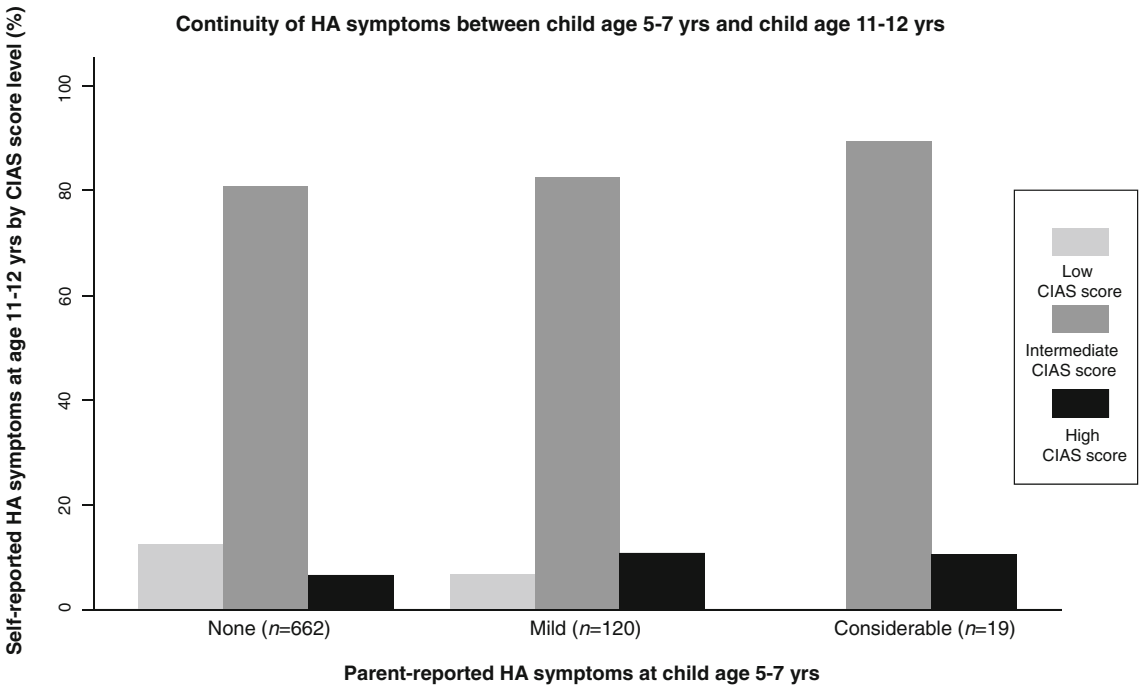

Fig. 2 Distribution of HA-symptoms (measured by CIAS scores) at child age 11–12 years in children with no, mild and considerable parental-reported HA-symptoms, respectively, at child age 5–7 years in the 801 children with data from both follow-up waves, *HA* Health Anxiety, *CIAS* Childhood Illness Attitude Scales

problems like chronic physical conditions and weight problems. Furthermore, the degree of HA symptoms was strongly associated with primary sector healthcare expenditures.

The CIAS total score and the distribution of individual CIAS symptoms generally confirmed those reported in a Canadian schoolchild population (Wright and Asmundson 2003). Thus, many 11–12 year old children apparently experience a fraction of the HA symptoms covered by the CIAS. Seeking help from parents when the child felt in pain or sick was frequently reported which indicates that this behavior related to illness is normal in preadolescents. In contrast, general illness worries and hypochondrical beliefs were rarer, suggesting these cognitions may specifically be an expression of significant HA. Illness worry may be related to an underlying medical condition (Asmundson et al. 2010). However, chronic physical conditions were not found to account for the expressed level of concern. This suggests that for the most part, the children reported unexplained illness worries, which are descriptively closer to the diagnostic criteria of hypochondriasis in the ICD-10 and the former DSM-IV, now primarily designated as illness anxiety disorder in the DSM-5. In a future study, we plan to further evaluate the psychometric properties of individual CIAS items by factor analyses in order to identify items that might contribute to distinguishing among respondents and inform the construct of HA in relation to preadolescents.

The associations between high levels of HA symptoms and concurrent unspecific somatic symptoms and emotional disorders found in the present study on adolescents correspond to findings from studies of adult populations which indicate symptom overlap among hypochondriasis and somatization, panic disorders, depression, phobias, and OCD (Creed and Barsky 2004). Yet, findings show that hypochondriasis is a separate condition that is typified by health-related anxiety (Deacon and Abramowitz 2008). In accordance with the latter, we found that in 74.5 % of the children with a high HA symptom score, no other mental health condition was identified by the DAWBA which covers various anxiety disorders in childhood, but has no specific section on hypochondriasis. This may suggest that HA in younger age groups, like in adults, can represent a separate construct.

Healthcare expenditures, measured approximately 2 years before study inclusion, remained significantly associated with the highest HA symptom score after adjustment for comorbid chronic physical conditions. This suggests that group differences could not solely be explained by differences in physical health status. To our knowledge, no other directly comparable data in children and adolescents have previously been published, but our findings are consistent with studies on adults showing considerable economic effects of severe HA with increased health care utilization (Fink et al. 2010; Looper and Kirmayer 2001; Martin and Jacobi 2006; Sunderland et al. 2013). Thus, our findings may point to a stable pattern of increased health care-seeking behavior with more attendance and pathology testing in persons with high levels of illness worries irrespective of age.

Adult patients with severe HA tend to have persistent complaints (Creed and Barsky 2004). In accordance with this, we found significant associations between HA symptoms measured at two different ages, 5–7 years and 11–12 years, which supports the continuity of significant symptoms. Also, consistent with findings in adult populations, a high level of HA symptoms was not associated with socioeconomic factors like maternal education or family income (Fink et al. 2004). We found that children of foreign-born parents reported more HA symptoms than children of Danish-born parents, which suggests that cultural differences in styles of talking about the body and health may influence illness worry. However, future research is needed to further examine this issue.

HA in adults is equally frequent among men and women (Creed and Barsky 2004; Fink et al. 2004). In contrast to this we found that preadolescent girls reported a higher symptom score than boys. This finding may be rooted in bodily changes in both sexes and in changes in affective symptoms in general in girls during puberty, and corroborates previous findings by Eminson et al. (1996) on adolescents' illness attitudes.

Strengths and Limitations

The present study's strengths are the detailed and systematic HA symptom assessment in a large population-based sample and the contemporary, independent comprehensive assessment of psychopathology and use of health care costs. Its main limitation is attrition with higher participation among children with more favorable socioeconomic characteristics. However, most of these characteristics did not predict HA status, and the base rates of chronic physical conditions, overweight, mental disorders and healthcare utilization among participants correspond well to the prevalence of long-term illness (13 %), overweight (14 %), mental morbidity (12 %), and mean healthcare costs in primary health services (214 Euro) reported in large surveys representative of Danish children (sources: National Institute of Public Health, Denmark & Statistics Denmark). We therefore have no reason to consider severe confounding due to attrition per se.

Besides the face validity the psychometric properties of the Danish version of CIAS was not further tested prior to the study. However, in a subsequent preliminary factor analytic investigation (data not shown) our findings were very similar to those originally proposed by the authors of the CIAS (Wright and Asmundson 2005). Furthermore, the descriptive statistics of the CIAS items in the present study were comparable to the results described in the Canadian school sample on which the CIAS was first tested. This seems to support that there are no major cultural differences in HA and its measurement in Canadian and Danish children.

The HA assessment at child age 5–7 years relied on only three items. Nonetheless, these items were carefully constructed and their validity supported by confirmative factor analysis (Rask et al. 2012). Another methodological aspect was the use of self-reports rather than a multi-informant approach for the HA assessment. However, when it comes to information of anxiety problems in older children, the validity of reports by other informants such as parents or teachers have been questioned as they have no direct access to the nature or the extent of the child's inner distress (Achenbach et al. 1987; Choudhury et al. 2003).

Due to the lack of useful diagnostic criteria for severe HA (i.e., hypochondriasis or illness anxiety disorder) in children, we used arbitrary cut-offs to determine subgroups of children with low and potentially clinically significant, high levels of HA symptoms, respectively. Also, we could not examine the potential influence of parental health and illness worries on the level of the child's HA (Marshall et al. 2007). Finally, inclusion of data on the full range of available health services could have provided a more comprehensive picture of the associated healthcare expenditure.

Implications

The novelty of the present study lies in its examination of a wide range of illness worries and illness attitudes in a non-clinical sample of children. The main findings indicate that excessive concern about illness and health is non-trivial in childhood and may, like in adults, entail increased health care costs. In most of the children with the highest level of HA symptoms, the symptoms were not found to be part of another anxiety disorder or depression suggesting that HA is a distinct phenomenon already in childhood. Improved and earlier recognition of illness worries by health professionals may therefore potentially prevent repeated consultations and medical examinations and the development of severe HA that needs intensive and more costly intervention. This could not only improve quality of life for the young persons affected, but could also contribute to improved functioning in adult life and more effective use of health service resources.

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Conflict of Interest The authors declare that they have no conflict of interest

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