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Predictors of health care utilization in young children with recurrent pain – a population-based study

Background: Recurrent pain is a common experience in childhood, but only few children with recurrent pain attend a physician. Previous small-scale studies yielded conflicting findings with regard to predictors of health care utilization in children with recurrent pain. **Methods**: The present study analyzes a subset of the data from the German Health Interview and Examination Survey for Children and Adolescents (KiGGS) study. Specifically, our sample comprised n= 2,149 young children (3-10 years old) with recurrent pain to find robust predictors. We used multiple logistic regressions to investigate age, gender, SES, migration background, pain intensity, pain frequency, pain-related disability, somatic symptoms, HRQL, as predictors for visiting a doctor due to pain. Additionally we investigated the variability of the predictors to assess the sample size needed to make reliable claims about predictors of health-care utilization. **Results**: Overall, 1144 (53%) children consulted a physician due to recurrent pain. Young girls with high pain-related disability, -intensity, –frequency, and migration background were more likely to attend a physician. Pain-related disability had the largest impact. Socioeconomic status, health-related quality of life and somatic symptoms were not systematically related to health care utilization. An analysis of the variability of these results indicated that several hundred participants are needed until the results stabilize. **Conclusions**: Our findings highlight the importance of pain-related disability and frequency in assessing the severity of recurrent pain. Generic predictors and demographic variables are of lesser relevance to children with recurrent pain. On a methodological level our results show that large-scale population-based studies are need to reliably identify predictors of health care utilization.

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Predictors of health care utilization in young children with recurrent pain – a population-based study

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Introduction

Recurrent pain in children and adolescents is a pervasive health care issue but only between 36% and 54% of the children with chronic pain visit a physician (Perquin et al., 2001; Ellert, Neuhauser & Roth-Isigkeit, 2007; Huguet & Miró, 2008). Over the last ten years a number of studies aimed to describe those children who not only have recurrent pain but also visit physicians or specialized treatment centers (Peng et al., 2007; Wager et al., 2013b). Factors associated with physician visits due to recurrent pain may be relevant to better understand children seeking professional help, and shape the health care system.

So far, only three studies have systematically investigated pain- and demographic characteristics as predictors of health care utilization in pediatric pain patients (Perquin et al., 2001; Huguet & Miró, 2008; Toliver-Sokol et al., 2011). These studies agree that pain characteristics are associated with pain-related health care utilization. Children with continuous pain, high pain frequency and high pain intensity are more likely to visit a physician (Perquin et al., 2001; Huguet & Miró, 2008). Furthermore, interference with daily activities and school absence due to pain are factors associated with health care utilization (Perquin et al., 2001; Huguet & Miró, 2008; Toliver-Sokol et al., 2011). These studies found conflicting findings concerning demographic characteristics. While one study indicates that girls with chronic pain seek health care more often than boys (Perquin et al., 2001), other studies did not replicate this gender difference (Huguet & Miró, 2008; Toliver-Sokol et al., 2011). Similarly, one population-based study found that younger children seek a physician more often (Ellert, Neuhauser & Roth-Isigkeit, 2007), the other studies did not replicate these findings (Perquin et al., 2001; Huguet & Miró, 2008). Some generic variables, e.g. comorbid somatic diseases, health-related quality of life (HRQL) have only been studied once (Perquin et al., 2001). Furthermore, variables that are

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highly relevant predictors of health care utilization in other contexts such as socioeconomic status (SES) or migration background, have rarely been studied, and if have been found to not be related to health care utilization (Perquin et al., 2001; Toliver-Sokol et al., 2011). Reasons for these inconsistencies may be small sample sizes (N) relative to the number of variables studied (K), and use of univariate analysis (Huguet & Miró, 2008). One study (Perquin et al., 2001) tested K=28 variables in a sample comprising N=254 children with chronic pain from a larger epidemiologic study, the other study used multiple linear regression analysis to test K=6 variables in N=59 patients (Toliver-Sokol et al., 2011). Such small number of cases per variable may result in spurious findings and overall highly variable effect-estimates.

The aim of the present research is to identify robust predictors of health care utilization in children with recurrent pain in a large population-based study. Specifically, we used a multiple logistic regressions approach to investigate age, gender, SES, migration background, pain intensity, pain frequency, pain-related disability, somatic symptoms, HRQL, as predictors for visiting a doctor due to pain. The secondary aim is to describe the variability of such estimates and determine the sample size that is needed to yield stable estimates for the predictors.

Materials and Methods

Subjects

The design of the Kinder KiGGS study (Kurth et al., 2008) as well as demographics of children in pain reports are described previously (Ellert, Neuhauser & Roth-Isigkeit, 2007). We analyzed only a subset of the 4,986 children whose parents reported (1) the child had pain at least once in the past three month, (2) data on all predictor variables (see below). As a result, data from 2,149 children (3-10 years; 7.41 years ± 2.25; 54% female) were analyzed.

Measures

As part of the KiGGS study parents answered questions regarding demographic information and different aspects of pain in the proceeding three months. Health care utilization was assessed with one item asking whether the child visited a doctor due to his/her pain problem. The five response categories ranged from "never" to "always". For the present analysis these were dichotomized by collapsing all responses from "once" to "always" and testing those who attended a physician at least once vs. those who never attended a physician.

We used demographic, pain-related and generic variables as predictors of health-care utilization in children. Demographic variables were age, gender, socioeconomic status (SES), and migration background. The SES includes information on the parental education, their occupation as well as the family income (Lange et al., 2007). It was divided into "high", "middle" and "low". Migration background was defined as either 1) the child being migrated and at least one parent not being born in Germany or 2) both parents being migrated and being no German citizen (Lange et al., 2007).

We assessed several pain-related predictors for health care utilization; pain-related disability, pain-frequency, and pain-intensity. We calculated a comprehensive pain disability measure by adding up the impairment in different areas of everyday life including school, meeting friends, appetite, sleep, hobbies (Hirschfeld & Zernikow, 2013). Children were asked to judge their pain-related impairment for each aspect on a scale ranging from "never" (=1) to "always" (=5). Average pain intensity was measured with a 100 mm visual analogue scale. Pain frequency in the past three months was described on a scale ranging from "once a month" (= 2) to "daily" (= 6).

Furthermore, we assessed general predictors for health care utilization; HRQL, and mental health. HRQL was assessed with the KINDL-R (Bullinger et al., 2008). This 24-item questionnaire covers six dimensions of HRQL. For this study we used the scales “psychological well-being” and “physical well-being”. Aspects of well-being were rated on a 5-point Likert-scale. The strengths and difficulties questionnaire (SDQ) (Goodman, 1997) is a screening instrument covering aspects of “emotional problems”, “hyperactivity”, “conduct problems” and “difficulties with peers”. These were summed up to a total score of somatic symptoms.

Data analysis

Data were analyzed in two steps. First, predictors of health care utilization were identified using multiple logistic regression analysis. In order to make the odds ratios (ORs) comparable across predictors measured on different scales, predictors were scaled by dividing by two standard deviations before being entered into the logistic regression (Gelman, 2008). This allows interpreting ORs for continuous predictors similar to ORs from binary predictors as the added – or reduced - risk of participants with higher scores compared to lower scores.

Second, the variability of the parameter estimates was assessed using a sequential sampling approach. For this the trajectories of the estimates were calculated by sequentially adding participants one by one to the analysis. From these trajectories the point of stability (POS) was identified for each variable. We defined the POS as the number of participants that had to be included until the significance of this specific effect did not change any more (Schönbrodt & Perugini, 2013). Because trajectories and its’ corresponding POS are specific to the particular order in which participants were added to the analysis we replicated this analysis for 1.000 random orders of participants because. From the distribution of the POS in the bootstrapping sample we calculated the POS*crit* from which at least 80% of the trajectories stabilized. Inspection of the POS for 1.000 sequences and POS*crit* can tell a researcher how many participants would have to be sampled before the solution converges (Schönbrodt & Perugini, 2013).

Results

Predictors of health care utilization

Overall, we found that 1144 (53%) of the children with recurrent pain consulted a physician due to their recurrent pain. pain-related disability was the strongest predictor of whether or not a child would visit a physician due to recurrent pain (OR = 5.37 ; 95%CI = 4.15 – 7.02), children with high disability, due to pain were five times more likely to visit a physician (tab. 1). As can be seen in figure 1, five other variables were also significant predictors but had much smaller ORs; pain-intensity (OR = 2.05; 95%CI = 1.66 – 2.54), pain-frequency (OR = 1.67 ; 95%CI = 1.37 – 2.03), migrant (OR = 1.64; 95%CI = 1.12 – 2.41), sex (OR = 1.22 ; 95%CI = 1.01 – 1.47), age (OR = .66; 95%CI = 0.54 - 0.79). Overall, young girls with high pain-related disability, -intensity, –frequency, and migration background had higher probabilities to visit a physician. Socioeconomic status, health-related quality of life and somatic symptoms were not systematically related to physician visits.

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insert figure 1 about here

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insert table 1 about here

Variability of predictor estimates

Figure 2 shows the trajectory of the estimates, i.e. the ORs from the logistic regression based on different subsamples of patients. This indicates that the estimates of the effects change depending on how many participants are added to the analysis. The ORs for most effects converge to 1, i.e. a null-effect, in the first 250 participants. Critically the ORs may even reverse, e.g. the effect of migration background is smaller than 1 up until about 450 included participants, from which point on the effect becomes larger than 1.

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insert figure 2 about here

Inspection of the point of stability, which reflects how many participants are needed to make a stable decision about whether or not a variable is significant or not (tab. 1) revealed that the effects of HRQL and SES were insignificant throughout the trajectory. However, even the huge effect of pain-related disability was only stable from 117 participants onwards, and the effect of pain frequency needed 531 participants to stabilize. Of note three variables (Migration, Sex, and SDQ) needed over 1,000 participants until their effect could be reliably detected.

Inspection of the POS from the random sequences (fig. 3) demonstrates that the findings concerning the POS are not specific for the order in which the participants were sampled, i.e. most effects stabilized only after several hundred participants were included in the analysis. This is also reflected in the POS*crit* for the individual effects (tab. 1). Of note, while the effect of HRQL seemed to stabilize with few participants in the specific order studied above, this effect stabilizes relatively late when alternative orders are considered. Across the thousand different orders, the effect of pain-related disability stabilized with the fewest number of participants while the effect of sex, which was borderline significant in the full sample, stabilized extremely late.

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insert figure 3 about here

Discussion

The aim of the present study was to identify predictors of health care utilization in children with recurrent pain. We found that pain-related disability was the largest and most robust predictor of health care utilization. Several other variables that predicted health care utilization in other contexts (SES, HRQL, SDQ) were not systematically related. An analysis of the variability of these results showed that large samples are needed to identify significant effects. In what follows we will discuss the findings with regard to health care utilization before describing the general strengths and limitations of the study.

We found that pain-related disability and pain intensity are significant predictors of health care utilization. These findings support the assumption that not ongoing pain itself, but the suffering, e.g. in terms of pain-related disability, makes the difference between chronic pain as a clinically relevant condition and as a private phenomenon. In line with our results, several previous studies have suggested these two factors as significant predictors for health care utilization (Perquin et al., 2001; Huguet & Miró, 2008; Toliver-Sokol et al., 2011). This finding underlines the need for a more holistic definition of clinically relevant chronic pain. Most studies have tried to define meaningful levels of pain-intensity (Hirschfeld & Zernikow, 2013), less attempts have been made to use criteria other than pain-intensity to describe the severity. Purves and colleagues (Purves et al., 1998) have suggested to include a “recent or frequent seeking of treatment or use of analgesic medication” as a measure for a relevant pain problem. Our data suggests that in addition to medication use, pain-related disability may be a key factor to judge pain severity. Such an approach has been implemented in the Chronic Pain Grading (Von Korff et al., 1992) and its pediatric adaption (Wager et al., 2013a) which includes pain intensity and pain-related disability to classify patient to different levels of pain severity.

Our results show that age and sex are significant albeit small predictors for health care utilization. Age was not a significant predictor in previous studies (Perquin et al., 2001; Huguet & Miró, 2008). These studies, however, included children with larger age ranges, 8 to 16 and 0 to 18, respectively (Perquin et al., 2001; Huguet & Miró, 2008). It may be that there is only a local association for age in the age range of this study sample (3-10 years). When looking at the association between age and health care utilization within a larger range, encompassing also adolescents, this effect may cease. However, it may also be, that the sample size in these studies was too low to detect this effect. Previous findings are conflicting with regards to sex; while sex did not have an influence on health care utilization in one study (Huguet & Miró, 2008), another study finds girls to be more likely to use health care (Perquin et al., 2001). Close inspection of the stability of our findings suggest that the effect of sex stabilizes extremely late, i.e. small sample sizes utilized in previous studies may be responsible for these inconsistencies.

Another significant predictor for health care utilization was a migration background. Children with a migration background were more likely to visit a physician. This difference may not be explained by ethnicity, but rather by effects of acculturation (Chan, 2012). US-studies with adult chronic pain patients did not find an effect of ethnicity (Meghani & Cho, 2009). However, it was shown that a higher level of acculturation is associated with reduced pain threshold and pain tolerance (Chan, 2012). We found no evidence for attending a physician for pain-treatment depending on SES. In contrast to this access to specialized treatments seems to depend on parental SES (Wager et al., 2013b). In studies with adult chronic pain patients, results concerning the association between health care utilization due to chronic pain and socioeconomic status are conflicting. While some report an increased utilization in patients with lower income (Meghani & Cho, 2009), others report increased utilization in those with a higher socioeconomic status (Lim, Jacobs & Klarenbach, 2006). As reported in a previous study, general psychological factors seem to be of little relevance to health care utilization [18]. Neither psychological well-being nor mental difficulties are associated with visiting a doctor. Taken together we found that pain-specific measures were much more important to predict health care utilization in children with recurrent pain than demographic or generic measures.

On a methodological level we were able to show that reliably determining the significance of individual predictors in multiple logistic regression affords extremely large data sets. Sometimes effects that are significant in one direction change their direction later on. The sequential sampling approach taken here suggests that much larger sample sizes than employed in previous studies (Perquin et al., 2001; Huguet & Miró, 2008; Toliver-Sokol et al., 2011) are needed to substantiate claims about the significance of individual predictors. As demonstrated by the results concerning the effects of sex, this problem is especially severe when the significance or not significance of small effects is assessed. This is in line with a recent studies that used this method to define the sample size necessary to stabilize correlation coefficients and factor loadings (Schönbrodt & Perugini, 2013; Hirschfeld, Brachel & Thielsch, 2014). Solutions to these problems are developed within the accuracy in parameter estimation (AIPE) approach to reporting study results and sample size planning (Kelley & Maxwell, 2003). In contrast to traditional null-hypothesis significance testing approach (Neyman & Pearson, 1928) that exclusively focuses on whether or not a specific effect is null, or not, AIPE focuses on assessing estimates for effects with a given precision. This opens the possibility that while an effect may be significant in one study and non-significant in another, there is still the possibility that the parameter estimates in both studies overlap.

Limitations

Several limitations need to be kept in mind when interpreting the results of the present study. Most of these are due to the fact that the data were from a large population-based survey that did not assess pain-related variables with the level of detail that is possible when a smaller group of patients is assessed (Hirschfeld & Zernikow, 2013). This may be especially true for the measure of pain-related disability. However, the presumably low stability of results cannot be explained by lack of reliability alone because the more comprehensive measures for HRQL and somatic symptoms did not yield more reliable effects. Nevertheless, future population-based studies should expand their focus on pain as a central variable, and develop measures that balance the need for more detailed information on pain-related health care utilization and brevity.

Conclusion

The aim of present study was to identify robust predictors of health care utilization in children with recurrent pain. We found that pain-related disability was by far the most important predictor for health care utilization, with children scoring high on this measure having a five-fold increased risk to attend a physician. Pain-intensity and frequency are also significant but of lesser relevance. This further supports the choice of this variable rather than pain-intensity as core-outcome in pediatric trials (McGrath et al., 2008). Furthermore, we demonstrated that multiple logistic regression analysis yields results that are much less stable than one may believe. As a result disagreements between studies may be due to chance alone. In order to substantiate specific claims about individual predictors we urge researchers to use sequential sampling techniques or bootstrapping to scrutinize the robustness of their results.

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Table 1

Results of the logistic regression analysis and sequential sampling

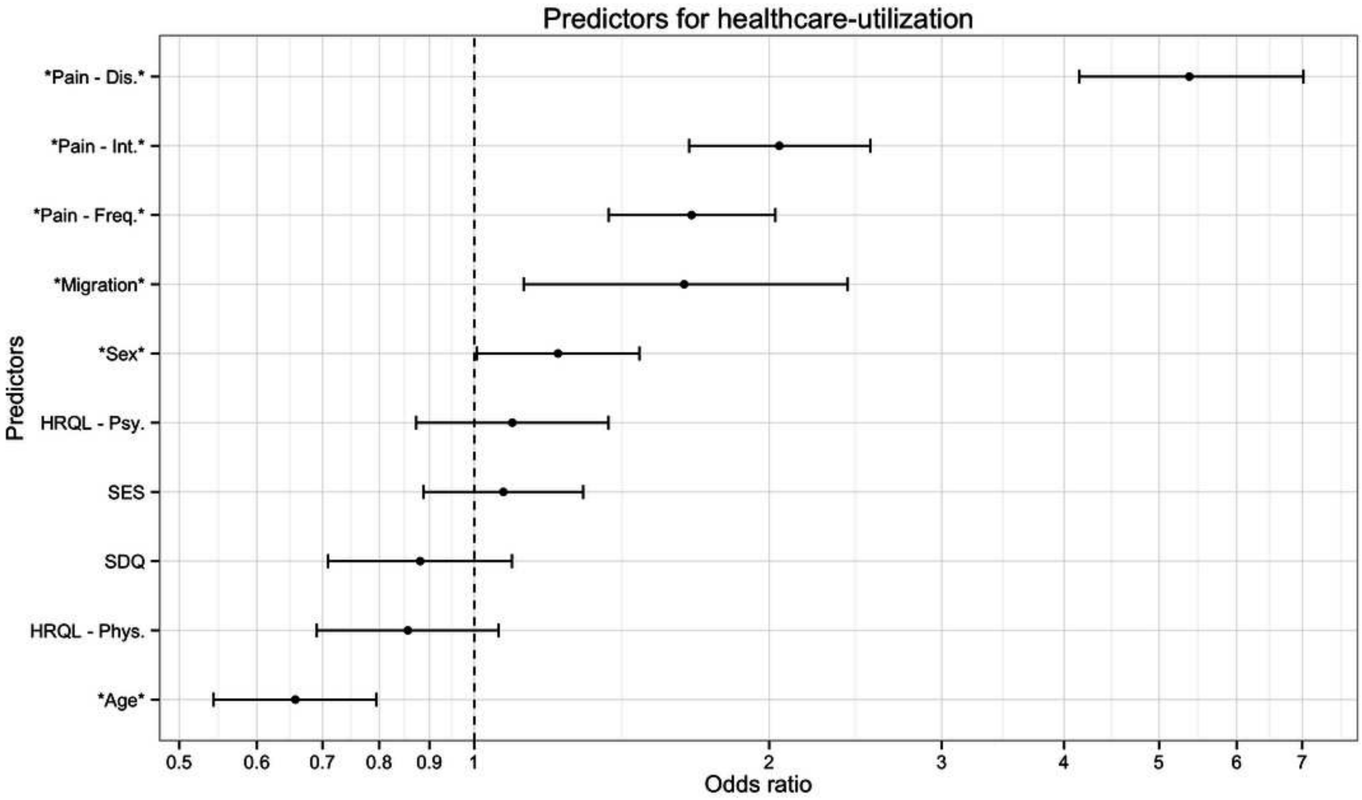
	Full sample (n= 2,149)			Sequential sampling	
		95% CI	95% CI		
	OR	lower	upper	POS	POS*crit*
Pain-related					
disability	5.37	4.15	7.02	117	109
Pain intensity	2.05	1.66	2.54	224	414
Pain frequency	1.67	1.37	2.03	531	666
Migration	1.64	1.12	2.41	1697	1844
Sex	1.22	1.01	1.47	2144	2143
HRQL - Psy.	1.09	0.87	1.37	50	332
SES	1.07	0.89	1.29	50	301
SDQ	0.88	0.71	1.09	1196	761
HRQL - Phy.	0.86	0.69	1.06	79	1571
Age	0.66	0.54	0.79	701	902

Note: OR = Odds ratio; CI = confidence interval; POS = Point of stability; POS*crit* = Critical Point of stability; HRQL = Health related quality of life; SES = socioeconomic status; SDQ = Strength and difficulties questionnaire;

1

Predictors of health care utilization

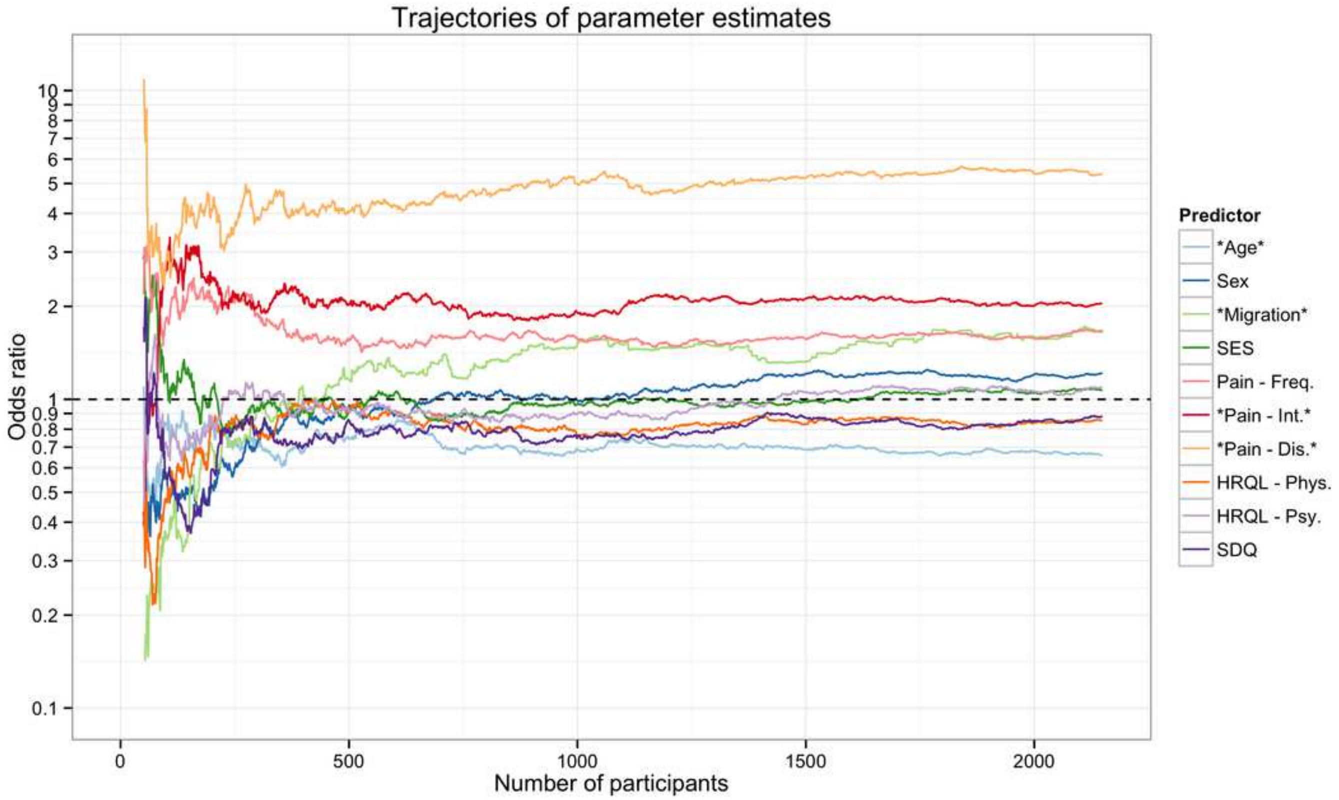
Error bars indicate 95% Confidence intervals. Stars denote predictors that were significant in the full sample. Pain – Dis. = Pain-related disability; Pain-Int. = Pain intensity; Pain-Freq. = Pain frequency; HRQL-Psy. = Health related quality of life psychological; HRQL-Phys. = Health related quality of life physiological; SES = Socioeconomic status; SDQ = Strength and difficulties questionnaire



2

Trajectory of the odds ratios for one sampling order

Stars denote predictors that were significant in the full sample. Pain – Dis. = Pain-related disability; Pain-Int. = Pain intensity; Pain-Freq. = Pain frequency; HRQL-Psy. = Health related quality of life psychological; HRQL-Phys. = Health related quality of life physiological; SES = Socioeconomic status; SDQ = Strength and difficulties questionnaire



3

Point of stability for the parameter estimates

Stars denote predictors that were significant in the full sample. Pain – Dis. = Pain-related disability; Pain-Int. = Pain intensity; Pain-Freq. = Pain frequency; HRQL-Psy. = Health related quality of life psychological; HRQL-Phys. = Health related quality of life physiological; SES = Socioeconomic status; SDQ = Strength and difficulties questionnaire