The etiology of functional somatic symptoms in adolescents

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Chapter 3

Adolescents with low intelligence are at risk of functional somatic symptoms

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ABSTRACT

Purpose: *Low intelligence is a risk factor for functional somatic symptoms (FSS) in adults, but it is unknown whether a similar association exists in adolescents. We hypothesized that low intelligence may lead to FSS, and that this association is mediated by low school performance. In addition, we hypothesized that this mediation is particularly present in adolescents who perceive high parental expectations.*

Methods: *This study was performed in a general population cohort from the TRacking Adolescents' Individual Lives Survey, using data from the first wave (N = 2,230, mean age = 11.09 years, SD = .56, 50.8% girls), second wave (N =2149, mean age =13.65 years, SD=.53, 51.0% girls), and third wave (N = 1816, mean age = 16.25 years, SD = .72, 53.3% girls). Intelligence was measured using the Wechsler Intelligence Scale for Children—Revised, which resulted in an intelligence quotient (IQ) for each participant. FSS were measured by the Somatic Complaints Scale of the Youth Self-Report. School performance was assessed by teacher reports and perceived parental expectations by adolescent reports. Structural equation modeling was used to test our hypotheses.*

Results*: We found a significant negative association between IQ and FSS in the whole group (β = .24). This association was significant in the group perceiving high parental expectations (β = .37), but not in the group perceiving low parental expectations. The association between IQ and FSS was not mediated by school performance.*

Conclusions*: Low intelligence is associated with a higher predisposition for FSS in adolescents, especially in those adolescents perceiving high parental expectations.*

INTRODUCTION

Functional somatic symptoms (FSS), defined as somatic symptoms not conclusively explained by known organic pathology, are frequently seen in health care (Fink et al., 2005;Wessely et al., 1999). The etiology of FSS is still elusive, although it is becoming increasingly clear that it is multifactorial, involving complex interactions between biological, psychological, and social factors (Brown, 2004;Deary et al., 2007;Rief and Broadbent, 2007). Intelligence might be one factor contributing to the etiology of FSS. We previously found a negative association between intelligence and FSS in a general adult population cohort, which was partly mediated by an unfavorable work situation (Kingma et al., 2009).

It is not clear whether the association between intelligence and FSS is generalizable to the adolescent population. Moreover, it is unknown which factors would mediate this association, and whether these factors differ from those observed in adults. Most adults spend a great amount of time at work, whereas adolescents spend much time at school. Therefore, instead of an unfavorable work situation in adults, an unfavorable school situation might mediate the association between intelligence and FSS in adolescents. Indeed, intelligence is the most important predictor of school performance (Ivanovic et al., 2004), while low school performance in its turn has been associated with FSS (Campo et al., 1999). Thus, low school performance may mediate the association between intelligence and FSS in adolescents.

However, it is plausible that low intelligence and low school performance do not result in FSS in all adolescents. The burden of low school performance might depend on the norms of the social environment of the adolescent. A study on chronic fatigue syndrome (CFS), a syndrome defined by the existence of a cluster of FSS, suggested that parents might play an important role. Parental expectations of the intelligence of adolescents with CFS were significantly higher than parental expectations of the intelligence of adolescents without CFS (Godfrey et al., 2009). The authors suggested that these high parental expectations might contribute to the development and maintenance of CFS (Godfrey et al., 2009). It might be that when parental expectations cannot be met by the adolescent, this may lead to distress and consequently FSS in the adolescent. Therefore, we hypothesized that adolescents with low intelligence and consequently low school performance are especially at risk for FSS when they perceive high parental expectations of their achievements. We studied our hypotheses in a large population cohort of adolescents.

METHODS

Sample and procedure

This study is part of the TRacking Adolescents' Individual Lives Survey (TRAILS). TRAILS is a longitudinal cohort study of Dutch adolescents. The study was approved by the Dutch Central Committee on Research Involving Human Subjects. Data from the first, second and third assessment waves are involved in this study. These assessment waves ran from March 2001 to July 2002, from September 2003 to December 2004, and from September 2005 to August 2008. For the sample selection, five municipalities in the North of the Netherlands were asked to give information from the community register of all citizens who were born between October 1, 1989 and September 30, 1990 (first two municipalities), or between October 1, 1990 and September 30, 1991 (last three municipalities), yielding 3483 names. Next, all 135 primary schools (including schools for special education) within these municipalities were asked to participate in TRAILS. School participation was a requirement for participants and their parents to be approached by the TRAILS staff. Of all schools 123 (90.4% of the schools accommodating, 90.3% of the children) agreed to participate in the study. Of the 3145 remaining eligible children 210 were excluded because they were either unable to participate or incapable to participate due to severe mental retardation or due to a serious physical illness or handicap, or if no Dutch-speaking parent or parent surrogate was available (Turkish and Moroccan parents who were unable to speak Dutch were interviewed in their own language) (Huisman et al., 2008). After fully explaining the procedures, written informed consent from the parents was obtained. At the second and third assessment wave, informed consent was obtained from the adolescents themselves. Of all approached adolescents (N = 3145), 76.0% (N = 2230, mean age = 11.09, SD = .56, 50.8% girls) were enrolled in the study. Detailed information about sample selection and analysis of non-response bias has been reported elsewhere (Huisman et al., 2008). Primary schools that participated in TRAILS were comparable to other primary schools in the Netherlands with regard to the percentage of children with a low socioeconomic background (16.1% and 15.3%, respectively) (Janssens et al., 2010). Ten percent (N = 230) of the sample had at least one parent born in a non-Western country, among which were Surinam (20.0%), Dutch Antilles (16.0%), Indonesia (16.0%), Morocco (6.5%), Turkey (5.5%), and other countries (36.0%). Of the 2230 baseline participants, 96.4% (N = 2149, mean age = 13.65, SD = .53, 51.0% girls) participated in the first follow-up assessment (T2), which was held two to three years after assessment wave 1 (T1). Of the 2149 participants at T2, 81.4% (N = 1816, mean age = 16.25, SD = .72, 53.3% girls) participated in the third assessment wave (T3), which was held two to three years after T2.

Measurements

Intelligence

At baseline, the intelligence of the participants was measured by psychologists using the shortened version of the Wechsler Intelligence Scale for Children Revised (WISC-R) (Wechsler, 1974), that resulted in an intelligence quotient (IQ) for each participant. Since the TRAILS cohort consists of a large group of adolescents, measuring intelligence of all adolescents with the WISC-III was too labor-intensive. Therefore, we used a shortened version of the WISC, the WISC-R

(Wechsler, 1991). The WISC-R is suitable for participants from the age of 6 to 16 years and 11 months (Wechsler, 1974) and is age-standardized in order to compare different age-groups with each other (Breslau et al., 2001). The shortened version of the WISC-R consists of a vocabulary subtest and a block design subtest. The WISC-R was assessed in a quiet environment and participants had 30 minutes time to complete both subtests.

Functional somatic symptoms

FSS were measured by the Somatic Complaints scale of the Youth Self-Report (YSR) (Achenbach et al., 2003), at all three assessment waves (T1, T2, and T3). This scale contains nine items, which refer to somatic complaints without a known medical cause (aches/pains, headache, nausea, eye problems, skin problems, stomach pain, and vomiting) or without obvious reason (overtiredness and dizziness). For each item, participants had to respond on a three-point-scale, with score 0: the participant did not experience the complaint in the preceding six months; score 1: the participant experienced the complaint sometimes or a little bit in the preceding six months; score 2: the participant experienced the complaint often or a lot in the preceding six months (Broberg et al., 2001;Ivarsson et al., 2002;Kantomaa et al., 2010). Factor analysis indicated that two items (eye problems and skin problems) had low factor loadings at both assessment waves for both girls and boys. This suggests that these two items did not represent the underlying construct very well in our sample and are therefore excluded. For the analyses, we composed sum scores of FSS.

School performance

Baseline school performance was rated by the participants' teacher for two school subjects: Dutch language and mathematics. We composed a mean score on school performance combining the scores on both school subjects divided by two. School performance at both follow-up waves was rated by the participants' teacher for five (groups of) school subjects; Dutch language, foreign languages (French, English, and German), geography and history, mathematics, and other exact sciences (biology, physics, and chemistry). For each (group of) school subject(s), performance was rated on a five point scale varying from 1 = insufficient performance to 5 = excellent performance. We composed a mean score on school performance combining the scores on the (groups of) school subjects divided by five.

Perceived parental expectations

At baseline, perceived parental expectations were assessed with two items from the EMBU-C (a Swedish acronym for my memories of upbringing) for Children (Markus et al., 2003). The EMBU-C has been developed to assess children's perception of parental rearing practices (Markus et al., 2003). The two items were: *"Do you think your father has high expectations as far as your school results, sport achievements and so on are concerned?"* and *"Do you think your mother has high expectations as far as your school results, sport achievements and so on are concerned?"* Possible answers could be: no, never = 1; yes, sometimes = 2; yes, often =3; yes, most of the time = 4. These four possible answers were merged to form two larger categories: low perceived parental expectations = 1-2 and high perceived parental expectations = 3-4. In particular, we were interested in high parental expectations; therefore we used data of the parent with the highest expectations, as perceived by the adolescent.

Description of the model

To model the relationships between IQ, school performance, and FSS, we first composed a trait and state (T&S) model of FSS, based on models of Duncan-Jones and others (Duncan-Jones et al., 1990). The composed T&S model is shown in Figure 1. At each time point FSS are determined by two latent variables: trait FSS (Tr1, Tr2, and Tr3) and state FSS (St1, St2, and St3). Trait FSS is stable over time and reflects unchanged risk factors. State FSS represents the variance not accounted for by trait FSS and therefore reflects changes in symptom scores over time (partly caused by error variance). A necessary assumption to identify the model is that the trait and state components are equal at each time point (Tr1 = Tr2 = Tr3; St1 = St2 = St3). The T&S model further includes autoregressive effects of the states (Au1 and Au2), meaning that the immediately preceding state value has a direct effect on the following state value. The T&S model is considered to represent the reality better than a completely autoregressive model, in which all stability in FSS scores is explained by the value of the preceding FSS score.

After having composed the T&S model for FSS, we connected this model to the measured variables school performance and IQ, as is depicted in Figure 2 and 3. We modeled one correlation; between school performance at T1 and state FSS at T1. Furthermore we modeled fourteen regression effects: a direct effect from IQ to trait FSS; three direct effects of IQ on school performance (T1, T2, and T3); two direct effect from school performance at T1 on school performance at T2, and from school performance at T2 on school performance at T3; two contemporaneous effects of school performance on state FSS (at T2 and T3); two contemporaneous effects of state FSS on school performance (at T2 and T3); two lagged effects of school performance on state FSS; and two lagged effects of state FSS on school performance. In order to identify the model it was necessary to remove the contemporaneous path from FSS on school performance at T2.

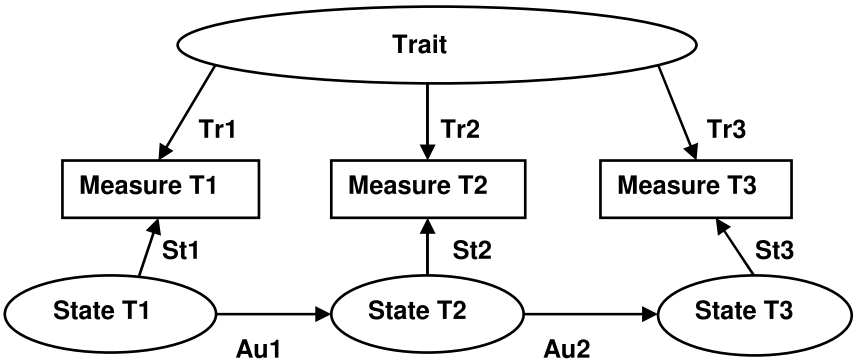

Figure 1. The trait and state model (T&S model). *Note that trait FSS at assessment wave 1 (Tr1) = trait FSS at assessment wave 2 (Tr2) = trait FSS at assessment wave 3 (Tr3) and state FSS at T1 (St1) = state FSS at assessment wave 2 (St2) = state FSS at assessment wave 3 (St3). The autoregressive effect at assessment wave 1 (Au1) and the autoregressive effect at assessment wave 2 (Au2) may differ across time points. T1 = assessment wave 1, T2 = assessment wave 2, T3 = assessment wave 3*

Statistical analyses

Descriptive statistics were calculated by SPSS version 16.0. In addition, we tested our hypotheses by structural equation modeling performed by M*plus* version 6.0. Model fits were considered good when the Comparative Fit Index (CFI) and the Tucker-Lewis index (TLI) were greater than .95, and the Root Mean Square Error of Approximation (RMSEA) was smaller than .05. Ideally, the χ^2 should be non-significant ($p > .05$), but larger samples increase the likelihood of obtaining significant *p*-values (Bentler, 1990). After testing the model in the total sample, we tested the model in two groups based on perceived parental expectations (high versus low). In addition, for the total group and for the two subgroups, we added requested all indirect effects between IQ and state FSS. Furthermore, we performed multiple imputation analyses by Mplus, including ten imputed datasets, as a sensitivity analysis to test for the influence of missing values.

RESULTS

Sample characteristics

Table 1 presents the scale scores on IQ, FSS, and school performance of the adolescents at the three assessment waves. All these variables were normally distributed. Table 1 shows that the prevalence of FSS declined during the waves. When categorizing perceived parental expectations as high or low, 1139 (51.9%) adolescents (56.5 % boys) perceived high parental expectations and 1056 (48.1%) adolescents (41.1% boys) perceived low parental expectations.

Table 1. Sample characteristics

Measure	Valid *N*	Mean	*SD*	Minimum – Maximum
IQ T1	2221	97.2	15	45 – 149
FSS T1	2115	3.3	2.5	0 – 13
FSS T2	2015	2.7	2.5	0 – 13
FSS T3	1636	2.4	2.4	0 – 12
School performance T1	1914	3.2	.9	1 – 5
School performance T2	1327	3.1	.7	1 – 5
School performance T3	886	3.0	.7	1 – 5

FSS = functional somatic symptoms;T1 = assessment wave 1, T2 = assessment wave 2, T3 = assessment wave 3

Model for the total sample

The model is depicted in Figure 2; only significant path estimates are given. The model fit was good (χ^2 [df = 3] = 3.72, p = .29; CFI = 1.00; TLI = .99; RMSEA < .01). The estimated trait variance in FSS ranged from 27% ($.52^2$) to 29% ($.54^2$). According to the model, there was a significant negative association between IQ and trait FSS. Furthermore, IQ was significantly positively associated with school performance at T1 and T2, while the association between IQ and school performance at T3 was not significant. School performance at T1 predicted school performance at T2, and school performance at T2 predicted school performance at T3. With regard to the paths between school performance and state FSS, no path was significant. Thus, there were no significant indirect paths between IQ and state FSS via school performance. State FSS at T1 predicted state FSS at T2, and state FSS at T2 predicted state FSS at T3. Estimates remained essentially the same after multiple imputation analyses.

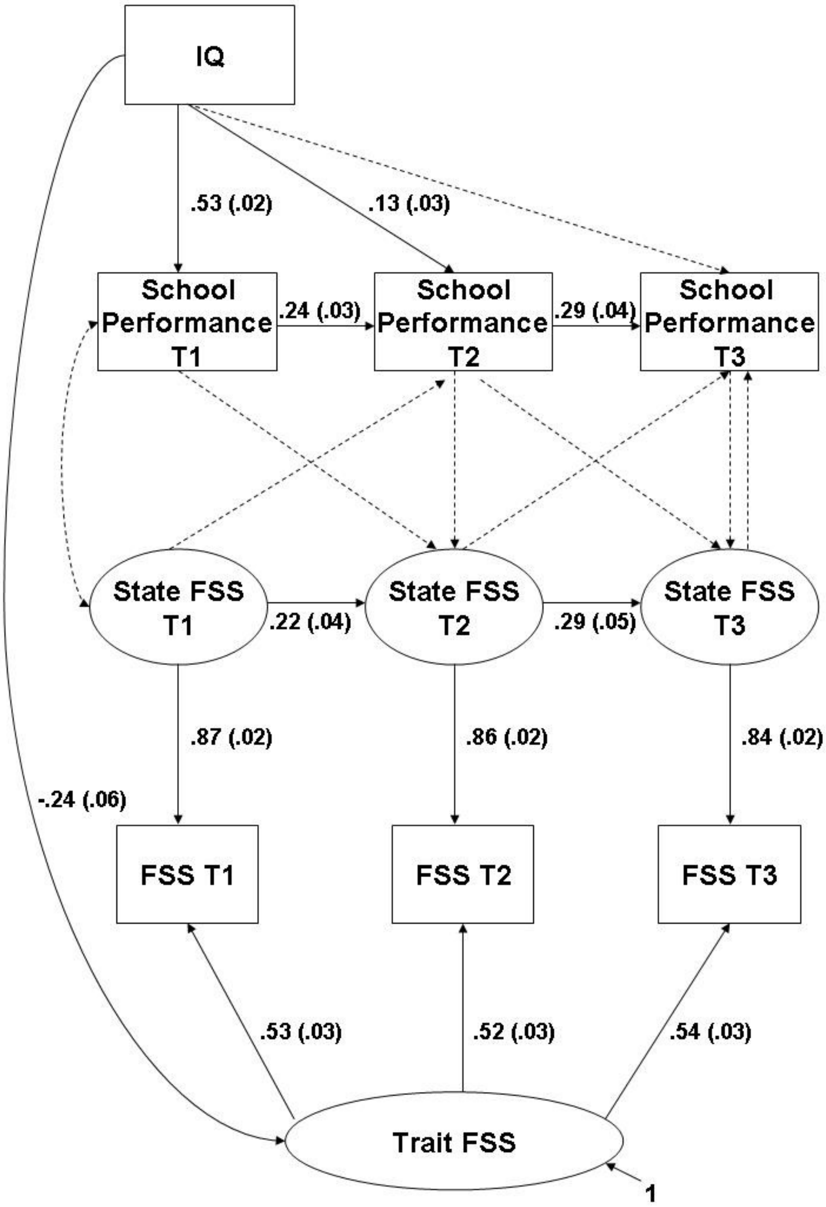

Figure 2. Relation between IQ, school performance, and FSS for the total group of adolescents. *Depicted are the standardized estimates (beta and standard error). The dotted lines represent the paths that are not significant. T1= assessment wave 1, T2 = assessment wave 2, T3 = assessment wave 3, FSS = Functional somatic symptoms*

Model for adolescents perceiving high parental expectations

The model is depicted in Figure 3; only significant path estimates are given. The model fit was good (χ^2 [*df* = 3] = 5.63, *p* = .13; CFI = .99; TLI = .98; RMSEA = .03). The estimated trait variance in FSS ranged from 25% ($.50^2$) to 28% ($.53^2$). According to the model, there was a significant negative association between IQ and trait FSS. Furthermore, IQ was significantly positively associated with school performance at T1 and T2, but not with school performance at T3. School performance at T1 predicted school performance at T2, but school performance at T2 did not predict school performance at T3. With regard to the paths between school performance and state FSS, no path was significant. Thus, there were no significant indirect paths between IQ and state FSS via school performance. State FSS at T1 predicted state FSS at T2, and state FSS at T2 predicted state FSS at T3. After fixing all paths between school performance and state FSS at zero, the model fit was good (χ^2 [df = 11] = 10.79, p = .46; CFI = 1.00; TLI = 1.00; RMSEA = .02), and the model did not significantly alter ($\Delta\chi^2$ [df = 8] = 5.16, p = .74). Estimates remained essentially the same aftermultiple imputation analyses.

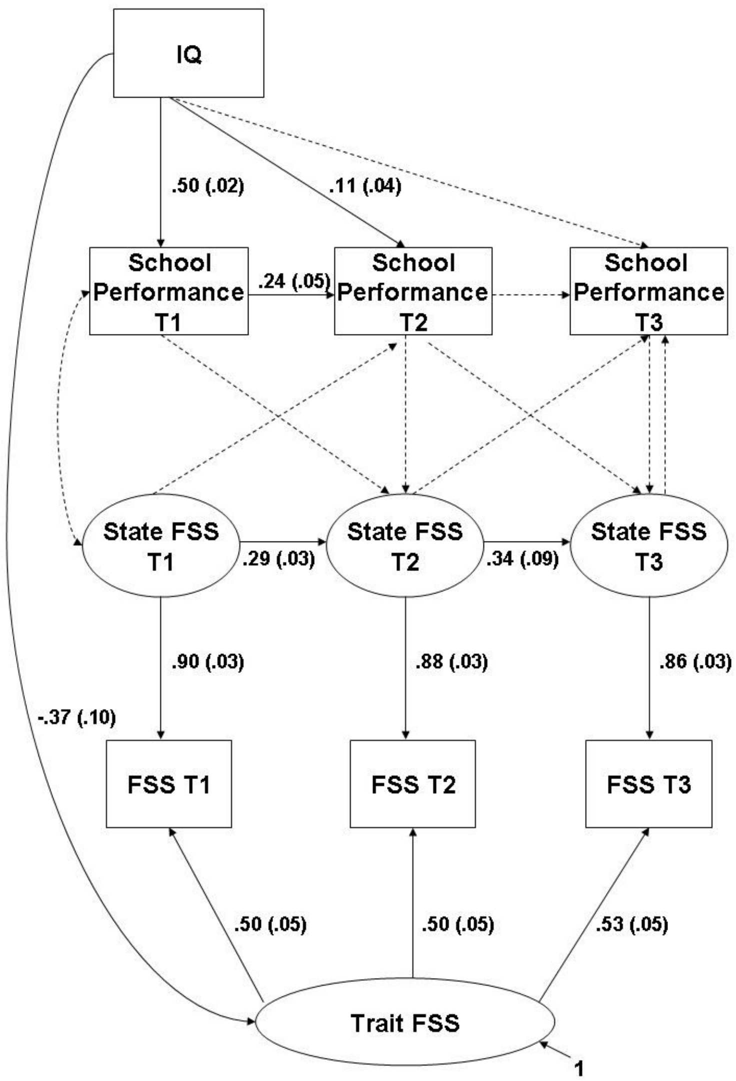

Figure 3. Relation between IQ, school performance, and FSS for adolescents perceiving high parental expectations. *Depicted are the standardized estimates (beta and standard error). The dotted lines represent the paths that are not significant. T1= assessment wave 1, T2 = assessment wave 2, T3 = assessment wave 3, FSS = Functional somatic symptoms*

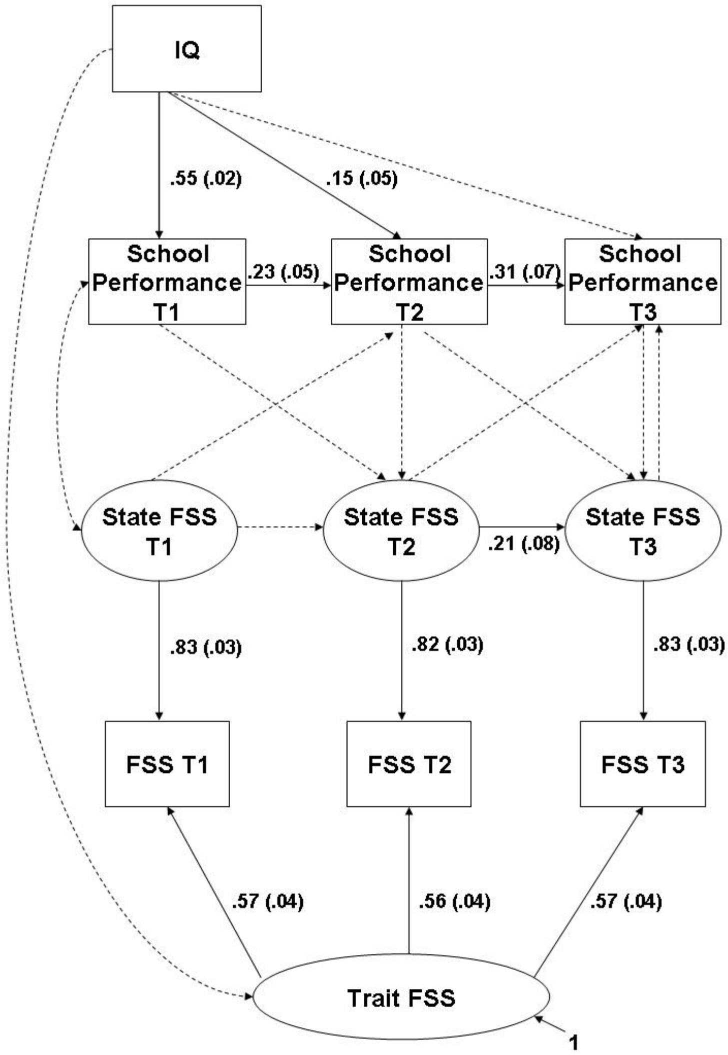

Figure 4. Relation between IQ, school performance, and FSS for adolescents perceiving low parental expectations. *Depicted are the standardized estimates (beta and standard error). The dotted lines represent the paths that are not significant. T1= assessment wave 1, T2 = assessment wave 2, T3 = assessment wave 3, FSS = Functional somatic symptoms*

Model for adolescents perceiving low parental expectations

The model is depicted in Figure 4; only significant paths are given. The model fit was good (χ^2 [*df* = 3] = 2.86, *p* = .41; CFI = 1.00; TLI = 1.00; RMSEA < .01). The estimated trait variance in FSS ranged from 31% ($.56^2$) to 33% ($.57^2$). According to the model, there was no significant association between IQ and trait FSS. Furthermore, IQ was significantly positively associated with school performance at T1 and T2, while the association between IQ and school performance at T3 was not significant. School performance at T1 predicted school performance at T2, and school performance at T2 predicted school performance at T3. With regard to the paths between school performance and state FSS, no path was significant. Thus, there were no significant indirect paths between IQ and state FSS via school performance. State FSS at T1 did not predict state FSS at T2, but state FSS at T2 predicted state FSS at T3. After fixing all paths between school performance and state FSS at zero, the model fit was good (χ^2 [*df* = 11] = 11.59, *p* = .40; CFI = . 99; TLI = .99; RMSEA = .02), and the model did not significantly alter ($\Delta\chi^2$ [*df* = 8] = 8.73, *p* = .37). Estimates remained essentially the same after multiple imputation analyses.

DISCUSSION

This study demonstrates that low intelligence is associated with a higher predisposition for FSS. School performance did not mediate the association between intelligence and state FSS. The association between intelligence and trait FSS was significant for adolescents perceiving high but not for those perceiving low parental expectations.

There are several strengths of this study. First, we used a large longitudinal population cohort without applying strict inclusion criteria. Therefore, results are likely to be generalizable to adolescents from the general population. Second, we used structural equation models with trait and state FSS to test our hypotheses. These models are preferred, because they are multi-dimensional and include FSS scores at specific time points, while also taking into account the underlying risk factor for FSS. Third, instead of using arbitrary cut-off points that might result in inevitable loss of information and power (Escobar et al., 1998), we strengthened our analyses by the use of continuous measures for FSS.

Besides strengths, there are also limitations that should be considered when interpreting our results. First, the WISC-R measures only two subtests for intelligence. Although intelligence was therefore not measured fully breadthways, the WISC-R includes a verbal subtest (vocabulary test) and a performance subtest (block design test), measuring verbal skills as well as spatial skills. Second, we only measured intelligence at the first wave. However, intelligence is a stable factor from the age of 10-12 years onwards (Waber et al., 2007). A third limitation is the fact that FSS were measured by self-reports. It is therefore not certain if FSS were truly not the result of conventional medical conditions. However, we previously performed a factor analysis which indicated that we were measuring one underlying construct (Janssens et al., 2010). In addition, it was explicitly stated in the questionnaire that the FSS had to occur without medical cause or without obvious reason. It may be argued that this complex statement was more difficult to understand for adolescents with low intelligence. Such bias would decrease the reporting of FSS in adolescents with low intelligence, which would imply that our results might be an underestimation of the negative association between intelligence and FSS.

To the best of our knowledge, we are the first to study the direct association between intelligence and FSS in adolescents. We found a negative association between intelligence and FSS in adolescents, which was not mediated by school performance. One study, comparing children that complain often of FSS with children that complain never or sometimes of FSS, found low school performance in children that complain often of FSS (Campo et al., 1999). In contrast to our general population study, that study focused on a clinical sample with severe problems.

Even though we found an association between low intelligence and risk of FSS as we hypothesized, results differed somewhat from our expectations. High intelligence was significantly associated with high school performance in primary school, but this association decreased in the subsequent measurement waves in which adolescents were in secondary school. Several explanations for this decrease can be proposed. Adolescents in secondary school are in an educational level matching their intelligence, explaining the decreasing strength between intelligence and school performance over time. Moreover, school performance in adolescence partly depends on motivation (Fortier et al., 1995) that might influence school performance more strongly than intelligence. Another explanation might be found in the way we analyzed our data. Part of the effect between intelligence and school performance at the second and third wave might be included in the autoregressive paths between school performances at different waves. Logically, this results in less strong effects over time between intelligence and school performance. When we performed simple regression analyses between intelligence and school performance at each wave, we found the same decrease in strength between intelligence and school performance over time, indicating that the autoregressive paths are not responsible for the decreasing correlation between intelligence and school performance.

Our results show that low school performance is not a risk factor for FSS in adolescents perceiving high parental expectations. Nevertheless, we found a significant negative association between intelligence and FSS in adolescents perceiving high parental expectations, while we found no association between intelligence and FSS in adolescents perceiving low parental expectations. These results seem quite similar to the findings in previous research, where parental expectations were higher in adolescents with CFS compared to healthy controls (Godfrey et al., 2009). However, that study was a small cross-sectional case-control study, while we studied a large longitudinal population cohort. Moreover, since we studied expectations related to both parents we were able to identify the parent with the highest expectations, as perceived by the adolescent, while the previous study looked at the view of only one parent. Our results suggest that perceived parental expectations influence the association between intelligence and FSS via other factors than school performance. In a previous cross-sectional study on perfectionism and well-being in adolescents (Stoeber and Rambow, 2007), it was found that adolescents that perceive parental pressure report more somatic complaints and had higher motivation to avoid failure (Stoeber and Rambow, 2007). Adolescents that perceive high parental expectations or pressure are thought to experience emotional distress (Stoeber and Rambow, 2007), which could be reflected in FSS. Alternatively, adolescents with low intelligence may tend to smoke more often and often have a high BMI, while smoking and high BMI are also associated with more FSS. Perhaps, adolescents with low intelligence that are distressed, due to highly perceived parental expectations, tend to smoke more and engage more often in unhealthy eating behaviors, resulting in FSS.

In conclusion, low intelligence is associated with a higher predisposition for FSS in adolescents, especially in those adolescents perceiving high parental expectations. These results suggest that the social context is important for a healthy development during adolescence. Clinicians dealing with adolescents with FSS could consider possible interactions between intelligence and perceived parental expectations, in order to understand the development of FSS in adolescents. In those cases in which parental factors are suspected to contribute to the development of FSS, it might be important to involve parents in the treatment.