

# Swedish Translation and Validation of the Pediatric Insomnia Severity Index

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## Research article

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# Abstract

**Background:** To increase health and well-being in young children, it is important to acknowledge and promote the child's sleep behaviour. However, there is a lack of brief, validated sleep screening instruments for children. The aim of this study was to present a Swedish version of the Pediatric Insomnia Severity Index (PISI), analyse the structure, test the validity and reliability of the instrument.

**Methods:** The English version of the PISI was translated into Swedish, translated back into English, and agreed upon before use. Parents of healthy 3- to 10-year-old children filled out the Swedish version of the PISI and the generic health-related quality of life instrument KIDSCREEN-27 two times. Exploratory and confirmatory factor analyses for baseline and test-retest, structural equation modelling, and correlations between the PISI and KIDSCREEN-27 were performed

**Results:** In total, 160 parents filled out baseline questionnaires (test), whereof 100 parents (63%) filled out the follow-up questionnaires (retest). Confirmative factor analysis of the PISI found two correlated factors: sleep onset problems (SOP) and sleep maintenance problems (SMP). The PISI had substantial construct and test-retest reliability. The PISI factors influenced all KIDSCREEN-27 dimensions.

**Conclusions:** The Swedish version of the PISI is applicable for screening sleep problems and is a useful aid in dialogues with families about sleep. It is also relevant in research and for evaluation of treatment. **Keywords:** Child; Child, Preschool; Health Promotion; Sleep; Translations; Pediatrics; Validation Studies; Quality of Life

## Background

Sleep disturbances in children are an increasing public health problem. One out of four children under the age of five has been reported by their parents to have sleep disturbances (1), leading to physical as well as behavioural problems (1-3). Sleep is essential for children's health and is associated with health-related quality of life (HRQoL) (4, 5), which includes children's well-being and subjective health.

To increase health and well-being in young children, it is important to acknowledge and promote the child's sleep behaviour. Child health care providers, who regularly meet young children and their parents, play a major role in detecting sleep disturbances in children (6, 7). However, parental knowledge about the signs and consequences of sleep disturbances in children is poor, and if parents do not recognize when their children's sleep habits fall outside the expected range for their age, they might not support and encourage the child to practise healthy sleep (8).

Children's sleep should be considered more seriously in the public health community, and a brief instrument with questions that captures the dimensions of sleep health well, is easy to administer, and is reliable and valid is needed to measure children's sleep (9). However, there is a lack of brief, validated sleep screening instruments for children (7, 8). To our knowledge, there is no brief, validated instrument in Swedish for measuring children's sleep.

The Pediatric Insomnia Severity Index (PISI) is a brief, 6-item parent-proxy instrument that has been validated and reliability-tested in English for quantifying insomnia symptoms in children 4–10 years old (10). Parent-proxy measures of children's (9–17 years old) sleep has been reported to agree equally with polysomnography and considered suitable for most clinical and research applications (11).

The primary aim with this paper was to present a Swedish translation of the PISI, analyse the structure, and test the validity and reliability of the translated instrument. The criterion validity was estimated in relation to a HRQoL instrument (KIDSCREEN-27). A further aim was to determine how the PISI is constructed to measure children's sleep at different ages.

## Methods

### Participants and procedure

Parents ( $n = 188$ ) of children 3–10 years old, with no major health problems, were asked to participate in the study when visiting child health care centres in Region Östergötland and public dental health services in Region Jönköping County for regular health visits with their children. After informed consent, the parents received a coded form with instructions and questionnaires. The completed form was placed in a postage-paid envelope and returned to the authors. Four weeks later, the parents received a new identical form at their home address together with a postage-paid envelope. The parents were contacted via phone by a research assistant if the form was not returned within two weeks, and if needed, once again after another two weeks. Data collection was ongoing between September 2018 and May 2019.

### Questionnaires

#### The Pediatric Insomnia Severity Index (PISI)

The PISI is a 6-item parent-proxy measure designed to monitor primary clinical symptoms of paediatric insomnia for children 4–10 years old, which was developed in the USA. The PISI items follow the International Classification of Sleep Disorders (ICSD-II) general criteria for insomnia (i.e., difficulties falling asleep, difficulties maintaining sleep, and daytime impairment). Items 1–5 are rated on a 6-point scale from “never” (0 points) to “always/7 days a week” (6 points), with a maximum score of 30 points. The total sleep duration (item 6) is rated on a 6-point scale estimating total hours of sleep on most nights, where a lower rate indicates more hours of sleep (0 = 11–13 hours of sleep and 6 = <5 hours of sleep). The PISI has been reliability and validity tested in children (4–10 years old) with a clinical diagnosis of insomnia at a sleep disorders centre in a paediatric hospital. A two-factor solution was established after removal of item 5 describing daytime sleepiness. The PISI is sensitive and has been validated for brief screening of insomnia symptoms or ongoing assessment during clinical care for paediatric patients. There is no cut-off score for insomnia symptoms (10, 12).

#### KIDSCREEN-27

For criterion validity, we compared the PISI with the validated and reliability-tested proxy version of the generic HRQoL questionnaire KIDSCREEN-27. KIDSCREEN-27 contains five dimensions of HRQoL: physical well-being (PHY, 5 items), psychological well-being (PWB, 7 items), autonomy and parent relations (PAR, 7 items), social support and peers (SOC, 4 items), and school environment (SCH, 4 items). Each item is scored on a 5-point Likert-type scale (1 = no agreement at all and 5 = total agreement), where higher values indicate better HRQoL, and the maximum score is 100 (13, 14). There are no cut-off scores for low or high HRQoL. Approval for use was obtained from the copyright holders.

#### Translation procedure

The process to translate the PISI was approved by Professor Kelly C. Byars of Cincinnati Children’s Hospital in October 2017. The translation was performed according to the guidelines provided by the ISPOR Translation and Cultural Adaptation group (15). The original English version was translated into Swedish by one of the authors (CA), whose native language was Swedish. This version was discussed and agreed upon (CA and PJ) before the Swedish version was translated back into English by a native English-speaking certified translator. This version was then reviewed by CA and PJ. No conceptual differences were found when comparing the Swedish version to the original English version (Suppl. file).

#### Statistics

Descriptive statistics were used to describe the study population and are reported in terms of means and standard deviations (sd) or in frequencies (*n*) and percentages (%).

The construct validity of the Swedish version of the PISI was established by exploratory and confirmatory factor analyses. To explore the factor structure of the six items in the PISI, data collected at baseline, exploratory factor analysis, principal component analysis, and factor analysis with oblique rotation were used. Criteria for the item to be retained in a factor were that they had to achieve a factor loading of at least 0.3. To determine the number of factors, eigenvalues larger than one, scree tree plots, and theory-based selection were used. In order to examine and test the extent to which the data collected could represent the factor model and be generalizable to the population, the final exploratory factor analysis was tested by performing two confirmatory factor analyses, one on data collected at baseline and the second one on data collected at test-retest.

Reliability was analysed by construct reliability, indicating to what extent the items in the PISI provide reliable measures of the factors. Values larger than 0.60 are desirable (16). We also explored reliability by analysing the association between the factors in the PISI at baseline and test-retest.

Criterion validity was explored by analysing the association between the factors in the PISI and HRQoL as assessed by KIDSCREEN-27. We assumed that the more problems with sleep, the poorer the HRQoL was. Thus, there should be a negative association between the PISI and KIDSCREEN-27. In the analysis of criterion validity, both correlations and structural equation modelling (SEM) was used to explore the associations of the factors in the PISI to KIDSCREEN-27. Goodness of fit tests are reported here as the chi-square ( $\chi^2$ ) value, including degrees of freedom (df), root mean square error of approximation (RMSEA) and comparative fit index (CFI). An overall RMSEA below 0.06 and a confidence interval range from 0.00 to 0.08 indicates a good fit. A CFI value equal or above 0.95 is considered a very good fit (17). In the SEM analysis, standardized effects found between 0.10 and 0.30 are considered to be small, effects found between 0.30 and 0.50 are considered as moderate, and effects greater than 0.50 are considered to be strong.

Descriptive statistics were analysed using SPSS version 25.0. The exploratory and confirmatory factor analyses and SEM analysis were performed with LISREL software. (18). A level of  $p < 0.05$  was regarded as statistically significant.

## Results

### Participants

In total, 160 parents filled out baseline questionnaires (test) and 100 parents filled out the follow-up questionnaires (retest). The average number of days between test and retest was 64.6 days (sd  $\pm$  39.2 days). Seventy percent of the questionnaires were answered by mothers. Mean age for the children was 6.9 years old (sd  $\pm$  2.2 years old, range 3.0–10.7 years old). Forty-four percent of the children were girls.

### Exploratory and confirmatory factor analyses

After a series of exploratory factor analyses, we found that the communality (common variance with other variables) of item 6 (hours of night sleep) was low, and accordingly, it was excluded in further analyses. The final exploratory model was found to have two factors: sleep onset problems (SOP) (item 1 “My child takes longer than 30 minutes to fall asleep after going to bed” and item 2 “My child has problem falling asleep at bedtime”) and sleep maintenance problems (SMP) (item 3 “My child awakes more than once during the night”, item 4 “After waking during the night, my child has trouble returning to sleep” and item 5 “My child appears sleepy during the day”). From confirmative factor analyses,

which were based on the exploratory factor model, we found that two dimensions are needed to account for the common variance between the five variables of the PISI.

Figure 1A and 1B present the confirmatory analysis two-factor solutions, SOP and SMP, for baseline and test-retest, respectively. Both models showed a good fit. The fit was  $\chi^2 = 0.43$ ,  $df = 3$ ,  $p = 0.93$ ,  $RMSEA = 0.00$ , and  $CFI = 0.99$  at baseline, and the fit was  $\chi^2 = 0.23$ ,  $df = 2$ ,  $p = 0.89$ ,  $RMSEA = 0.00$ , and  $CFI = 0.99$  at test-retest. As can be seen, SOP and SMP are positively correlated (baseline  $r = 0.27$ , and test-retest  $r = 0.38$ ). The construct reliability for SOP and SMP at baseline was 0.86 and 0.62, respectively. The corresponding value for SOP and SMP at test-retest was 0.71 and 0.76, respectively, indicating that the construct reliability of the Swedish version of the PISI is reliable and replicable.

To further analyse the construct validity and reliability, we explored (using SEM) how the SOP and SMP at baseline was associated with SOP and SMP at retest.

Figure 2 shows that the model has a good fit (i.e.,  $\chi^2 = 30.20$ ,  $df = 24$ ,  $p = 0.18$ ,  $RMSEA = 0.05$ , and  $CFI = 0.98$ ), and SOP and SMP at baseline were highly correlated with SOP and SMP at test-retest ( $r = 0.71$  and  $r = 0.72$ , respectively). Thus, SOP and SMP at baseline have a substantial effect or predictive power on SOP and SMP at test-retest. More than 50% of the true variance in SOP and SMP at test-retest can be explained by the variance of the factors at baseline. The baseline/test-retest correlations also support the reliability of the factors in the PISI.

To make the factors practicable, the means of the variables of each factor in the PISI have been calculated (with equal weight of the variables) and then correlated. As can be seen, the correlations of Figure 3 are in correspondence ( $r = 0.66$  and  $r = 0.77$ , respectively) with the model in Figure 2 ( $r = 0.71$  and  $r = 0.72$ , respectively).

It is possible that the child's age may influence the parent's response in the PISI. Therefore, we performed a re-analysis on the model in Figure 2 and controlled for age by means of partial correlation analysis. The results showed that the model was stable, thus the age of the children had no influence on the model.

Taken all together, this indicates that the two-dimensional structure of the Swedish version of the PISI has substantial construct and test-retest reliability.

## Criterion validity of the PISI and KIDSCREEN-27

To explore the criterion validity of the PISI, we analysed the correlations between the two factors in the PISI (SOP and SMP) from the baseline measurement and test-retest measurements to the five dimensions in KIDSCREEN-27. The correlations were optimized by means of confirmative factor analyses. The correlations between SOP and SMP from the two data collection points and the five dimensions in KIDSCREEN-27 were generally weak and non-significant for SOP (Table 1). But, SMP, on the other hand, correlated significantly with all dimensions in KIDSCREEN-27. However, SOP and SMP are correlated, and it can be reasonable to assume that the former affects the latter. Thus, problems with falling asleep in the evening (i.e., SOP) may cause sleeping problems during the night (i.e., SMP) (Figure 1).

Table 1. Optimally weighted correlations<sup>a</sup> between SOP and SMP and the five criterion dimensions of KIDSCREEN-27.

		School environment		Psychological well-being		Autonomy and parent relations		Social support and peers		Physical well-being	
		<i>r</i>	<i>p</i> -value	<i>r</i>	<i>p</i> -value	<i>r</i>	<i>p</i> -value	<i>r</i>	<i>p</i> -value	<i>r</i>	<i>p</i> -value
Sleep											
Onset	Test	-.07	.38	-.17*	.03	-.14	.09	-.16*	.04	-.06	.46
Problems	ReTest	-.10	.35	-.17	.10	-.04	.71	-.02	.85	.13	.22
Sleep Maintenance											
	Test	-.40*	<.01	-.36*	<.01	-.10	.23	-.23*	.04	-.31*	<.01
Problems	ReTest	-.47*	<.01	-.48*	<.01	.52*	<.01	-.26*	.01	-.42*	<.01

<sup>a</sup> Pearson correlation coefficient (*r*)

\* Significant correlations (*p* <.05)

Therefore, we performed a series of SEM analyses using SOP and SMP. In these models, we assumed that SOP had an effect on SMP, which in turn, had effects on HRQoL (i.e., the different dimensions in KIDSCREEN-27).

Figure 4 shows the model for PWB. The model had a good fit ( $\chi^2 = 51.83$ , *df* = 41, *p* = 0.19, RMSEA = 0.04, and CFI = 0.97) and showed that SMP has a direct effect (*B* = -0.49), indicating a decreasing effect on PWB. For SOP, there was a direct effect (*B* = 0.52) on SMP, indicating that SOP increases SMP, and also an indirect negative effect on PWB (*B* = -0.26), indicating that SMP is a mediating factor between SOP and PWB.

Table 2 presents the indirect and direct effects from SOP and SMP on the dimensions of KIDSCREEN-27. As can be seen, SOP and SMP had effects on all dimensions of the KIDSCREEN-27. The models showed that there were significant direct effects of SMP on the criterion measures and significant indirect effects of SOP on the criterion measures. However, in the SOC dimension, no significant indirect effect of SOP could be found. The predictive power (i.e., the ability to “explain” the variance of the criterion dimensions) of the two factors ranged from 7% to 27% (23% for PSY, 18% for PHY, 27% for PAR, 7% for SOC, and 22% for SCH).

When scrutinizing the KIDSCREEN-27-dimensions, we found a mean correlation between the five dimensions of .44, and accordingly, a “second order factor” was to be expected. In a confirmative second order factor analysis, we found that the five dimensions form a second order general KIDSCREEN-27 factor, and SMP (test-retest) has a factor loading of -.48 with the general KIDSCREEN-27 factor ( $\chi^2 = 8.42$ , *df* = 9, *p* = 0.49, RMSEA = 0.00, CFI = 0.99). Thus, the SMP dimension is directly or indirectly related to all five KIDSCREEN-27 factors and explains 23% of the variance of the general KIDSCREEN-27 factor.

Table 2. Correlations between the PISI and KIDSCREEN-27.

Criterion-dimension "Re-test"	Physiological well-being (PHY)		Autonomy and parent relations (PAR)		Social support and peers (SOC)		School - environment (SCH)		Psychological well-being (PWB)	
	Indirect Effect	Direct Effect	Indirect Effect	Direct Effect	Indirect Effect	Direct Effect	Indirect Effect	Direct Effect	Indirect Effect	Direct Effect
Effects "Re-Test"										
SOP "Re-Test"	-.14		-.26		-.19 (n.s.)		-.21		-.26	
SMP "Re-Test"		-.32		-.47		-.19		-.45		-.49
Model fit-indices										
Chi-square	38.06		56.45		29.00		24.21		51.83	
df	30		44		25		22		41	
P	.15		.10		.25		.37		.19	
RMSA	.05		.05		.04		.03		.04	
CFI	.97		.97		.98		.98		.97	

Direct and indirect effects from structural equation models of the factors sleep onset problems (SOP), and sleep maintenance problems (SMP) on the KIDSCREEN-27 domains Physiological well-being, Autonomy and parent relations, Social support and peers, School environment and Psychological wellbeing. The figures in the table are based on the models from the re-test-situation. n.s = non-significant

## Discussion

In the present study, the PISI was translated into Swedish. Reliability and validity was tested in healthy children 3–10 years old as compared to Byars et al. (10) who tested the PISI in a population of children with a clinical diagnosis of insomnia at a sleep disorders centre. In both studies, the PISI was found to be well suited for assessment of children's sleep despite different populations (i.e., children diagnosed with insomnia/healthy children and children with different nationalities).

From confirmative factor analyses, we found that two correlated factors, SOP and SMP, were needed in order to explain the co-variances between the variables of the instrument. These results are in line with the results from Byars et al. (10). The construct reliabilities (indicating to what extent the markers provide reliable measures of the construct or factor) were larger than 0.60. What this study adds is that the test-retest reliabilities of the two factors were high, indicating that about 50% of the variance of the re-test was explained by the baseline test. Because of assumed changes in sleep problems during the time between the test situations, the test-retest reliabilities presented are underestimates. Accordingly, the items of the PISI are reliable measures of SOP and SMP.

We assumed that problems with falling asleep in the evening (SOP) caused sleeping problems during the night (SMP), and the time factor supports the causality (i.e., SOP → SMP) of the two correlated factors. This conclusion in combination with our findings that only SMP is directly related to the KIDSCREEN-27 dimensions formed the basis for

the model in which SOP influences SMP, and SMP, in turn, influences the KIDSCREEN-27 dimensions. Of special interest is that significant indirect effects were also found between SOP and the KIDSCREEN-27 dimensions. These indirect effects clearly indicate that SMP acts as a mediator, and without this factor, no effects of SOP on the KIDSCREEN-27 dimensions have been found. The model represents a simplex structure or quasi-Markov chain (a sequence in which each event is dependent on the state in the previous events), which often has been found to represent psychological processes.

The Swedish version of the PISI explains a substantial proportion of the true variance of the criterion dimensions and has effective and practicable criterion validity with respect to its short number of items in comparison to the number of items in KIDSCREEN-27. It is also of interest to note that the PISI factors influence all five KIDSCREEN-27 dimensions. A conclusion is that the PISI factors represent sleep problems of general importance for most areas of functioning. The strong correlation between the PISI and the second order factor of KIDSCREEN-27 supports the PISI's relationship to HRQoL. This indicates that the poorer sleep is, the poorer HRQoL and vice versa.

In the present study, we found strong correlations between sleep and HRQoL. There are few studies of sleep and HRQoL in young children. An Australian study reported that sleep quality predicted HRQoL in children 10–11 years old (19). In Finland, Gustafsson et al. (4) found an association between sleep duration and HRQoL in children 10–15 years old. Contradictory results were found by Price et al. (20), who showed weak and inconsistent correlations between sleep duration and HRQoL in Australian children 4–9 years old. However, none of these studies used a validated sleep assessment tool. Moreover, an American study found associations between insomnia and HRQoL in children 7–10 years old, using ICSD-II (5). More research using a validated sleep assessment tool is needed to get more knowledge about sleep in healthy children and its correlation to HRQoL.

A strength of this study is that there was a high response rate, as 63% of the parents completed the questionnaires twice. Moreover, we included healthy children from different contexts (e.g., child care centres and public dental clinics) from different counties and the proportion of girls vs. boys was nearly 1:1. Therefore, our results could be generalized in healthy children in other clinic settings or county samples.

However, there are some study limitations that need to be considered. The number of days between the test and re-test were longer than planned, an average of 2 months. On the other hand, this did not seem to have any effect on the results. Another limitation is that only parents of healthy children or children with minor health problems were included in the study. The Swedish version of the PISI has not been validated in children with major health problems. As the PISI is answered by proxy and the items are developed from ICSD-II criteria for insomnia, we suggest that the PISI could even be used in other groups of children.

Considering the high prevalence of sleep disturbances in young children, there is a need to acknowledge and promote sleep in children. A lack of brief instruments to measure children's sleep may make it difficult for health care professionals to determine sleep problems in young children. To counteract the negative effects of insufficient sleep, a public health policy is essential to help prioritize sleep health in children (9). The PISI could be used in a dialogue about the child's sleep during health care visits in primary health care centres as well as other contexts, such as dentistry and school. Moreover, the PISI is a brief measurement for research in both healthy children and children with poor sleep. Further investigations of critical values of the PISI to find a cut-off score could be helpful for symptom screening and future research studies of sleep in children.

## Conclusions

The Swedish version of the PISI, as a proxy report instrument, is a useful tool for identifying sleep problems and can aid in dialogues with families about sleep. The PISI is also applicable for evaluation of treatment for sleep disorders and in

sleep research.

## Abbreviations

CFI = Confirmatory Fit Index

PAR = Autonomy and parent relations

PISI = Pediatric Insomnia Severity Index

PHY = physical well-being

PWB = Psychological well-being

RMSEA = The *Root Mean Square Error of Approximation*

SCH = School environment

SOC = Social support and peers

SOP = Sleep onset problems

SMP = Sleep maintenance problems

## Declarations

Ethics approval and consent to participate

Ethical approval for the study was obtained by the Regional Committee for Medical Research, Linköping, Sweden (dnr 2018/175-31). Informed written consent was obtained from all participants.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

CA and ALS devised the project and the main conceptual ideas. CA, ALS and PJ participated in the study design for the translation process, which was performed by CA and PJ. All authors (CA, PJ, ES and ALS) participated in the design of the validation and reliability-test of the PISI. CA and ALS were responsible for data collection. EP conducted the statistical analyses. All authors participated in the interpretation of data and contributed equally to the writing of the manuscript. All authors read and approved the final manuscript.

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