Prevalences and correlates of sleep problems among adolescents in specialty mental health services and in the community: What differs?

BJØRN REIGSTAD, KIRSTI JØRGENSEN, ANNE MARI SUND, LARS WICHSTRØM


Aims: Knowledge of sleep problems and their relationships among adolescent psychiatric patients is limited. This study investigated whether adolescents in specialty mental health care differ in rate and correlates of sleep problems from adolescents in a community sample; 2538 adolescents from a community sample were compared with a representative clinical sample of 129 adolescent patients. Methods: Comparisons were made on frequent sleep problems according to scores on the Youth Self-Report, the Mood and Feelings Questionnaire, and instruments assessing coping styles, stresses and family functioning. Results: Sleep problems were more frequent in the clinical sample than the community sample (31.3% vs. 5%). Sleeping little and being overtired were the most common sleep problems. Sleep problems were multivariately associated with internalizing problems in both samples. Poor family functioning and distractive coping were multivariately associated with sleep problems among adolescent patients, whereas depressive symptoms were multivariately associated in community adolescents. Conclusions: Prevalences of sleep problems were high among adolescent patients. However, sleep problems may be in danger of being unnoticed in clinical practice. Clinicians should ask about such problems and be aware of possible connections with family functioning, depression and suicidality. Therapeutic interventions directed towards sleep problems should be considered.

Knowledge of sleep problems among youths have been limited (1), though, the last years research on the epidemiology of adolescent sleep problems and their co-morbidities have been increasing (2–7). Sleep problems in children and adolescents are commonly reported by parents, and vary in epidemiological studies between 5% and 43% (7–11). It is well known that sleep problems in adults are associated with a variety of psychiatric disorders (12–15), and are associated with a range of psychiatric problems in children and adolescents including suicidal risk (6, 16), depression (17, 18), post-traumatic reactions (19), behavioural disorders (20, 21), attention-deficit/hyperactive disorder (ADHD) (14, 22, 23), eating disturbances (24), autism and Asperger’s disorder (25). Johnson et al. (7) reported from a US community study that 53% of adolescents suffering from a DSM-IV-defined insomnia had a comorbid psychiatric disorder.

Sleep patterns change from childhood to adulthood. In a longitudinal study, Gregory & O’Connor (2) found that the amount of sleep problems decreased from age 4 to 15 years. However, sleep problems at age 4 predicted behavioural and emotional problems in mid-adolescence. Several studies on sleep problems in children have found associations with behavioural/emotional syndromes on the Child Behavior Checklist (CBCL) (26) as well as relationship with DSM-III diagnoses (27, 28). Sleep problems are frequently associated with, and symptomatic of, several psychiatric disorders. Some studies on adults indicate that insomnia can predate depression, and that resolved insomnia reduces the risk for depression (29–31). Some case studies indicate that treatment of specific sleep problems may improve attention and reduce hyperactivity (32, 33). Sleep deprivation is also demonstrated to have negative effect on cognitive performance with possible harmful academic consequences for children and adolescents (4, 34, 35).

However, sleep problems in children and adolescents may be easily overlooked. Over 95% of severe sleep problems were reported only by the children themselves.
in a Finnish epidemiological study based on both parents’ and children’s reports (36). In another Finnish study, children’s sleep problems were associated with teacher-reported psychiatric symptoms but not with parent-reported (20). Parents may thus be unaware of their children’s sleep problems.

Besides population studies most studies are done on paediatric groups, or on selected psychiatric groups as inpatients or based on symptoms or diagnoses. To our knowledge, little is known about the prevalence of sleep problems and their correlates in representative child and adolescent psychiatric samples. For the clinician, it is presently not yet settled to what extent findings from population studies can be extrapolated to clinical populations.

**Aims**

We therefore ask if there are differences in frequent sleep problems between adolescents in a community sample and adolescents in clinical specialty mental health service with respect to: prevalence, gender, symptoms (psychiatric symptoms, pains, deliberate self-harm and suicide attempts); family (attachment and family functioning); psychological factors (cognitive styles and coping styles); and stress (life events and daily hassles).

**Method**

**Setting**

Adolescents in a clinical sample from the child and adolescent psychiatric outpatient clinics in Nordland County, Norway, were compared with adolescents from a community sample in the two neighbouring counties of Trøndelag. The Regional Ethical Committees and the Norwegian Data Inspectorate approved the study of both samples. Informed written consent was obtained for all participants. Confidentiality was guaranteed.

**The clinical sample**

Patients attending the child and adolescent psychiatric services in Nordland County, Norway, aged 12–18 were recruited consecutively by clinicians from June 2000 through 2001 (n=129). In all, 331 patients from the nine outpatient clinics were invited to participate, and 129 filled in the study questionnaire (participation rate=39%). No differences in diagnoses or in reasons for referral between patients from Nordland and patients from the rest of Norway (n=6692) were detected. However, patients referred in the Nordland County were 14 days older than patients residing in the rest of Norway (t=2.54, P<0.05), and were somewhat more often girls (61.4% vs. 55.2%; χ²=0.002). Comparisons were made with those who did not participate with respect to gender, age, referral problem and diagnosis. No exclusion criteria were used. The sample was representative with respect to referral problems and diagnoses. Information about referral problems and ICD-10 axis 1 diagnoses were collected from the patient’s medical notes (Table 1). Diagnoses were set by clinicians as a part of their ordinary clinical work. Pairwise comparisons showed that no ICD-10 axis 1 category occurred at different rate in the two groups.

The adolescents filled in the self-report questionnaire alone at the clinic they were attending, but had the possibility to ask for assistance if they needed. The adolescents then put the questionnaire in an envelope and sealed it themselves.

**The community sample**

The community sample stems from a representative sample of 2465 adolescents attending 22 private or public schools during 1999 in the two Norwegian counties of South and North Trøndelag (total population, n=9292) (second wave of data collection in the “Youth and Mental Health Study”) (37). The two counties neighbour the county of Nordland. Cumulative participation rate was 84.5%; 50.6% were girls. Schools were drawn with a probability according to size (proportional allocation). Details of the sampling procedure are reported elsewhere (38). Mean age was 15.0 years (range 13.8–16.9 years, standard deviation, s=0.58).

<table>
<thead>
<tr>
<th>% ICD-10 axis 1 diagnosis—largest groups</th>
<th>Clinical sample (n=129)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F32 Depressive episode</td>
<td>15.2</td>
</tr>
<tr>
<td>F40 Phobic disorders</td>
<td>2.6</td>
</tr>
<tr>
<td>F41 Other anxiety disorders</td>
<td>2.7</td>
</tr>
<tr>
<td>F43 Reaction to stress and adjustment disorders</td>
<td>22.5</td>
</tr>
<tr>
<td>F90 Hyperkinetic disorders</td>
<td>5.5</td>
</tr>
<tr>
<td>F91 Conduct disorders</td>
<td>3.1</td>
</tr>
<tr>
<td>F92 Mixed disorders of conduct and emotions</td>
<td>2.4</td>
</tr>
<tr>
<td>F93 Emotional disorders in childhood</td>
<td>5.6</td>
</tr>
<tr>
<td>F99 Not otherwise specified</td>
<td>13.8</td>
</tr>
</tbody>
</table>

**Measures**

The two samples received identical measures. Five items from the Youth Self-Report (YSR) (26) rate types and frequency of sleep problems: “I have trouble sleeping”; “I sleep less than most kids”; “I sleep more than most kids during day and/or night”; “I have nightmares”; “I feel overtired”. The YSR item assessing excess sleep was excluded because of low correlation with the other items. However, redundant sleep was registered through one of the items that was included. A total “sleep problem scale” was defined by the means scores of four items on the YSR and one item from the Mood and Feelings Questionnaire (MFQ) “I did not sleep...
as well as I do usually." This scale had adequate internal consistency (α=0.71). Similar problem scales based on the CBCL sleep items have been used in previous research by Stoleru et al. (39) and Gregory & O’Connor (2), and akin to the method used in those studies, we chose to use a single sleep problem scale because we wanted to assess general disturbances in sleep problems rather than several specific kinds of problems.

The YSR, which is the adolescent version of the CBCL (26) was used. Several studies have shown significant associations between DSM diagnoses and CBCL scores and YSR scores (40–45). It should be noted that items tapping sleep problems are not included in the present YRS scales.

The MFQ is a measure of depressive symptoms in children and adolescents (46). The MFQ has been useful in discriminating depressed and not depressed clinical cases, and to predict persistence of major depression in clinical samples (47, 48). A cut-off score of 27 was suggested by Wood et al. (49) from analysis of a clinical sample, and was used in the present study. Two items assessing sleep problems were omitted from the present sum score.

The adolescents were asked if they ever had taken an overdose or otherwise tried to harm themselves ("Yes, several times", "Once", "No"). After this gateway question, they were asked if they ever had tried to kill themselves (same options). Frequency of current pains in various locations (head, arms and legs, stomach, back) was recorded.

The questionnaire also contained modified versions of the following instruments: the Coping Inventory for Stressful Situations (CISS) (50); Coping with Depression Scale (51); Family Assessment Device (FAD), assessing the overall family functioning (52, 53); Inventory of Parent and Peer Attachment (IPPA) (54); the Early Adolescents Stress Questionnaire (EASQ) (55); and the Daily Hassles (55). Higher scores on these instruments indicate higher levels of problems with the exception of IPPA where higher scores indicate higher levels of secure attachment.

**Statistical analysis**

Differences in correlations between sleep problems and psychosocial variables and sleep problems were tested with stepwise multiple regression, forward inclusion. In order to compare the slopes of the betas between samples, two identical models were identified: this model included variables concurrently predictive of sleep problems in both or either sample. Differences in the magnitude of the regression coefficients were tested with a t-test for independent samples designed for this situation (56):

\[
t = \frac{b_1 - b_2}{\sqrt{SE_{b_1}^2 + SE_{b_2}^2}}
\]

**Results**

**Prevalence**

Table 2 presents prevalences of different types of sleep problem scores in the clinical sample and the community sample. About one third of the adolescent patients reported to have frequent sleep problems (score “very true” or “often true”) vs. 5% of the youths in the community sample. Girls had more sleep problems than boys, mean score = 0.42 vs. 0.29, t(2,400)=8.36, P<0.001.

The psychiatric patients had more sleep problems than the community controls, 0.80 vs. 0.37, t(2,423) = 12.88, P<0.001. Moreover, the gender difference was slightly higher in the clinical sample as evidenced by an interaction between gender and sample, F change of interaction = 4.07, df = 1/2400, P<0.05.

**Correlates**

Table 3 presents partial correlations between sleep problems and the MFQ and the YSR in the clinical sample and in the community sample, age and gender controlled. All symptoms correlated with sleep problems in both samples. In particular, sleep problems correlated highly

| Table 2. Percentages of type of sleep problem scores between adolescents in a community sample (n=2465) and adolescents in a clinical sample (n=129). |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| %               | Clinical sample (n=129) | Community sample (n=2465) |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| 0               | 1               | 2               | 0               | 1               | 2               |
| Sleep problems  | 50.0            | 18.8            | 31.3            | 84.8            | 10.0            | 5.2             |
| Less sleep than others | 45.3            | 27.3            | 27.3            | 70.6            | 22.1            | 7.2             |
| More sleep than others | 69.0            | 14.3            | 16.7            | 81.7            | 13.5            | 4.7             |
| Feeling overtired | 32.3            | 44.1            | 23.6            | 60.7            | 31.5            | 7.8             |
| Nightmares      | 49.6            | 35.4            | 15.0            | 73.3            | 23.5            | 3.2             |
| Do not sleep as usual | 44.4            | 30.2            | 25.4            | 73.3            | 19.1            | 7.6             |

0="Not true"; 1="Somewhat or Sometimes true"; 2="Very true or Often true".
YSR attention problems, YSR rulebreaking and YSR aggressive behaviour.

Table 4 presents differences controlled for age and gender between the clinical sample and the community sample in correlations between sleep problems and self-harm, suicide attempt and pains.

Strong correlations between sleep problems and all these variables were found in the community sample, whereas sleep problems and self-harm, suicide attempt and pains were significantly associated in the clinical sample.

In Table 5 are associations between sleep problems and family relations, coping styles, self-perceptions and stresses, respectively, in the two samples presented.

Sleep problems were correlated with most of these psychosocial variables. Moderately strong to strong correlations were observed with respect to: FAD, attachment to parents, daily hassles and life stresses, rumination, with YSR total scale, the internalizing scale, the somatic scale, and the anxious/depressed scale as well as the MFQ. These correlations were generally stronger in the community sample than in the clinical sample, and significantly so with respect to MFQ, YSR externalizing, YSR attention problems, YSR rulebreaking and YSR aggressive behaviour.

Table 4 presents differences controlled for age and gender between the clinical sample and the community sample in correlations between sleep problems and self-harm, suicide attempt and pains.

Strong correlations between sleep problems and all these variables were found in the community sample, whereas sleep problems and self-harm, suicide attempt and pains were significantly associated in the clinical sample.

In Table 5 are associations between sleep problems and family relations, coping styles, self-perceptions and stresses, respectively, in the two samples presented. Sleep problems were correlated with most of these psychosocial variables. Moderately strong to strong correlations were observed with respect to: FAD, attachment to parents, daily hassles and life stresses, rumination,

Table 5. Partial correlations between the sleep problem scale and other rating scales in the clinical sample and the community sample controlled for age and gender.

<table>
<thead>
<tr>
<th></th>
<th>Clinical sample r-value</th>
<th>Community sample r-value</th>
<th>Differences between r-values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n=129)</td>
<td>(n=2465)</td>
<td>(z-value)</td>
</tr>
<tr>
<td>FAD</td>
<td>0.302**</td>
<td>−0.305***</td>
<td>7.29***</td>
</tr>
<tr>
<td>IPPA, mother total</td>
<td>−0.312**</td>
<td>−0.281***</td>
<td>0.37</td>
</tr>
<tr>
<td>IPPA, father total</td>
<td>−0.221*</td>
<td>−0.295***</td>
<td>0.89</td>
</tr>
<tr>
<td>IPPA, friends total</td>
<td>−0.022</td>
<td>−0.086***</td>
<td>0.77</td>
</tr>
<tr>
<td>Daily Hassles total</td>
<td>0.522***</td>
<td>0.487***</td>
<td>0.42</td>
</tr>
<tr>
<td>Stressful events last year total</td>
<td>0.333***</td>
<td>0.410***</td>
<td>0.92</td>
</tr>
<tr>
<td>Coping depression—Ruminating</td>
<td>0.247*</td>
<td>0.388***</td>
<td>1.69</td>
</tr>
<tr>
<td>Coping depression—Distraction</td>
<td>0.053</td>
<td>−0.120***</td>
<td>2.05*</td>
</tr>
<tr>
<td>Coping depression—Problem Solving</td>
<td>−0.085</td>
<td>−0.025</td>
<td>0.72</td>
</tr>
<tr>
<td>Coping life events—Emotion Oriented</td>
<td>0.368***</td>
<td>0.379***</td>
<td>0.13</td>
</tr>
<tr>
<td>Coping life events—Avoidance Oriented</td>
<td>0.082</td>
<td>0.108***</td>
<td>0.31</td>
</tr>
<tr>
<td>Coping life events—Task Oriented</td>
<td>0.014</td>
<td>−0.018</td>
<td>0.05</td>
</tr>
</tbody>
</table>

*P<0.05, **P<0.01, ***P<0.001.

FAD, Family Assessment Device; IPPA, Inventory of Parent and Peer Attachment.
and emotion-oriented coping. However, the correlation between FAD and sleep problems was negative in the community sample and positive in the clinical sample. Distractive coping was negatively associated with sleep problems in the community sample, whereas not correlated in the clinical sample.

Table 6 shows multivariate associations between psychosocial variables and sleep problems in each sample. As can be seen, Internalizing problems were strongly associated with sleep problems in both samples. In addition, coping with depression in terms of distraction and FAD were both positively related with sleep problems in the clinical sample, and more strongly so than in the community sample. Sleep problems in community adolescents, however, were multivariately associated with depressive symptoms, which was not the case in the clinical sample (Table 6).

**Discussion**

Half of the adolescent psychiatric patients from the Nordland County, representative in referral problems and diagnoses, reported to have sleep problems, and almost one third had frequent sleep problems. The latter figure compares to a prevalence of 5% of adolescents in the community. This figure is low when compared with other community studies (7–11). In the present study, the prevalence of sleep problems in the community sample as well as in the clinical sample may thus be considered conservative. However, self-reports of sleep problems in clinical samples tend to be exaggerated compared with objective measures. This tendency could have biased the differences between the two samples in the present study.

The prevalences reported from sleep studies are diverse, reflecting diverse samples and study designs, use of different measures of sleep, and accordingly, the rates of sleep problems vary widely.

The most frequent reported problems in both samples were sleeping less than others and being overtired. Sleep problems were multivariately associated with internalizing problems in both samples. However, apart from this common factor, multivariate associations differed. Among patients, sleep problems were associated with poor family functioning and with distractive coping with stress. Among community adolescents, sleep problems were associated with depressive symptoms.

**Family characteristics**

Family functioning is identified to be the strongest factor associated with receiving specialty mental health care rather than severity of psychopathology per se (57–61). In the present study, reports of sleep problems by adolescents in the clinical sample as well as in the community sample were strongly correlated with poor family functioning and insecure attachment to parents, and among the adolescent patients poor family functioning was the strongest associated factor. Vignau et al. (62) reported that sleep problems among adolescents in the community were highly related to personal and family disruption. Family events are identified to be one of the most common precipitating factors related to the onset of insomnia (63). Several studies have found associations between maternal depression and sleep problems in younger children (39, 64, 65), and toddlers with sleep problems have been found more often to have mothers who are insecure with respect to attachment (66). Negative or insecure family relations may thus become stressors and parts of positive feedback loops related to sleep problems in childhood as well as in adolescence. Family characteristics thus seem to be an important issue in evaluation of sleep problems.

**Sleep problems and depression**

Sleep abnormalities seem to be associated with emotional as well as by accompanying behavioural problems and children with severe sleep problems are more likely to have a psychiatric disturbance (2, 20, 36). Results in the
present study are in line with these findings. Although sleep patterns are not necessarily diagnostic of particular psychiatric disorders as sleep irregularities may reflect an adolescent’s lifestyle, there are close relationships between sleep abnormalities and psychiatric disorders (12, 29).

The relationship between sleep problems and depression is verging on being tautological, because sleep problems are among the symptoms of depressive disorders. Hence, we eliminated items tapping sleep problems from our measure of depressive symptoms. In the present study, internalizing problems and depressive symptoms (community adolescents only) were strongly multivariately associated with sleep problems. This is in line with findings from community samples elsewhere (2, 17). However, at present the chronological ordering of sleep problems and internalizing problems is not yet settled. Breslau et al. (31) found in a longitudinal study of young adults that prior insomnia was a significant predictor of subsequent major depression, whereas others have found that depressive symptoms did predate sleep problems (3). Hence, it may be possible that the experience of sleeping difficulties could be strengthened by ruminative coping which is a specific coping style related to depressive disorders (51). In the present study, sleep problems were associated with ruminative coping in the clinical as well as the community sample.

From a developmental perspective, however, treatment of sleep problems in early childhood can possibly prevent behavioural and emotional problems in adolescence. Gregory & O’Connor (2) followed children longitudinally from ages 4 to 15 years and found that early sleep problems predicted later behavioural/emotional problems in mid-adolescence, and that correlation between sleep problems and depression/anxiety increased significantly during this age period. Thus, there seem to be a developmental change in the overlap between sleep problems and behavioural and emotional problems from childhood to adolescence. Sleep problems of a later age seem to be far more often associated with psychosocial difficulties or a psychiatric disorder.

Sadeh et al. (67) found that inpatient children’s self-ratings of depression, hopelessness and low self-esteem were significantly correlated with objective sleep measures indicating poorer sleep quality. These findings sustain associations found in the present study where sleep problems were correlated with depression and ruminative coping with depression. Sleep problems in this study were also significantly related to pain, self-harm and suicide attempts. Patients with major depression and sleep disturbances are found to be more likely to become suicidal than others (6, 68). Liu (69) found suicidal behaviour to be associated with short sleep duration and nightmares in adolescents in the community. Chronic pain combined with sleep disturbances is also found to increase the risk for suicidal ideation (70). Sleep problems in adolescent patients seem to be an important risk factor to be considered in clinical practice.

**Externalizing and attention problems**

The correlations between sleep problems in adolescents and externalizing behaviour in the present study are in line with other studies reporting relationships between sleep problems and behaviour problems in pre-schoolers and school-age children (20). Relationships between sleep problems and ADHD are found in several studies (14, 22, 23, 32), and the strong associations between sleep problems and the YSR “attention problems” subscale in this study seem to be sustained by those findings. Several studies have confirmed a good discriminative ability of this subscale on ADHD (71–73). In fact, sleep problems in early childhood might be an early sign of ADHD. Sadeh et al. (67) found associations between sleep and neurobehavioural functioning (NBF) in school-age children. These children also had higher rates of behavioural problems as reported by their parents on the CBCL. The relationship between sleep quality, NBF and behaviour regulation in child development raise significant questions about the genesis of these associations and their developmental and clinical implications.

**Coping with stress**

The strong relationships in the present study between sleep disturbances and the impact of stress are also found in other studies (74). Morin et al. (75) found insomnia to be related to stress and to emotion-oriented coping. Hall et al. (74) found that subjects with sleep problems experienced their lives as more stressful, and relied more on emotion-oriented stress coping strategies. A stronger tendency to experience stress-related intrusive thoughts was associated with greater sleep problems. Correspondingly, emotion-oriented coping was found to be the main coping strategy by adolescents with sleep problems in our clinical sample, and used by adolescents in the community sample as well. Multivariately, however, adolescent patients with sleep problems differed from adolescents in the community sample in use of distractive coping. This way of coping is also to be considered as a less adaptive stress handling strategy. Coping skills seem possibly to play an important role as mediators between stress and sleep. Treatment of sleep disturbances should accordingly include clinical methods adapted to teach effective stress assessment and coping skills.

**Outcome**

Multivariately, as well as bivariately, associations between sleep problems and psychosocial variables were partly different in the clinical sample from that in the community sample. This implies that although the clinician may be informed by studies of probability samples of ordinary
adolescents, correlates of sleep problems may be different among her or his patients. This is possibly the first study to address this issue in sleep problems, and findings need to be replicated before any strong conclusions can be drawn on exactly where the differences between patients and non-patients are, and to their explanations.

Limitations
Although the present study has many strengths, among them a large probability sample with favourable response rate, there are several limitations to be acknowledged. Firstly, the clinical sample was not completely representative of all adolescents referred to specialty mental health care. The low participation rate could have created some unknown selection bias related to sleep problems, which could have influenced the outcome. Those participating in the clinical sample were somewhat more likely to be a girl and older than those not participating. Although age and gender will be correlated among patients, this could have resulted in overestimation of the prevalence of internalizing behaviour. Importantly, those participating were not more likely to have been referred for internalizing problems or to receive an axis 1 diagnosis of an internalizing type. This differential attrition therefore most likely did not affect the overall results from this study. However, it should be taken into account that diagnoses were set by different clinicians in clinical practice and thus were not validated. Secondly, the study is based on self-reports and lacks objective measures. However, reports from children and adolescents themselves are found to be more reliable than those of parents (36, 76). Thirdly, the present cross-sectional design precludes causal conclusions, and prospective studies on clinical samples are much needed. Future studies should be supplemented with more confident methods as a sleep diary and/or objective measurements of sleep disturbances.

Conclusion
Sleep disturbances are far more common among adolescent psychiatric patients than in the adolescent population, and are correlated with self-harm, suicide attempts and a variety of different psychiatric problems. The sleep problem scale in the present study includes a variety of sleep disturbances that each needs different therapeutic measures. Clinicians should ask children and adolescents about sleep disturbances and consider therapeutic interventions accordingly. Sleep disorders in children and adolescents are often harmful to development and well-being, and may have negative consequences for academic success. The clinical services available to affected children and their families need to be improved. Further research is needed to verify if early recognition and treatment of sleep disturbances can prevent future psychiatric problems.

Acknowledgement—This study was funded with a grant from the Norwegian Research Council.

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

References

Bjørn Reigstad, Department of Child and Adolescent Psychiatry, Nordlandssykehuset, Bodø.
Kirsti Jørgensen, Department of Child and Adolescent Psychiatry, Nordlandssykehuset, Bodø.
Anne Mari Sund, Regional Centre for Child and Adolescent Mental Health, Department of Neuroscience, Faculty of Medicine, Norwegian University of Science and Technology, Trondheim.
Lars Wichstrøm is at Department of Psychology, Norwegian University of Science and Technology, Trondheim.