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Author(s): Aro, Tuija; Eklund, Kenneth; Eloranta, Anna-Kaija; Närhi, Vesa; Korhonen, Elisa; Ahonen, Timo

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Associations between Childhood Learning Disabilities and Adult-Age Mental Health
Problems, Lack of Education, and Unemployment

Abstract

We studied the impact of diverse subtypes of learning disabilities (LD) on adult-age mental health, education, and employment by comparing the LD group (n=430) with a matched control group without a known history of LD (n=2,149). The clinical archived data was merged with life-long register data on sickness allowances/disability pensions granted on the basis of psychiatric illnesses, reimbursements for psychoactive medication, having a degree after compulsory education, and received unemployment allowances. Differences emerged between the LD and control groups in all outcomes, suggesting that a higher proportion of individuals with LD had mental health problems compared to the control group, and a notable share of them had not attained a degree after compulsory education and had been unemployed for an extended period. Subgroup comparisons indicated that math disability (MD) was associated with antidepressant use and unemployment, whereas the reading disability (RD) group showed the least problems with employment. Interactions between subgroup and gender suggested that MD (with/without RD) may pose a higher risk than RD for females, whereas RD seemed to pose a risk for males. The findings suggest the need for researchers, clinicians, and those involved with adult education to consider mental health and educational problems among individuals with LD.

Keywords: learning disabilities, reading disability, math disability, comorbid RD+MD, mental health, education, employment, adult-age

Developmental learning disabilities (LD) affect around 5–15% of people (American Psychiatric Association, 2013). Reading disability (RD) is the most common and the far most investigated subtype of LD (see Shaywitz, Morris, & Shaywitz, 2008), while the other types of LD (e.g., math disability [MD] or comorbid conditions) have gained less attention until recently (e.g., Barbaresi, Katusic, Colligan, Weaver, Jacobsen, 2005; Dirks, Spyer, van Lieshout, & Sonnevile, 2008; Landerl & Moll, 2010; Moll, Göbel, & Snowling, 2015). Although developmental in nature, LDs are known to often persist into adulthood (Maughan et al., 2009; Morris, Schraufnagel, Chudnow, & Weinberg, 2009; Raskind, Goldberg, Higgins, & Herman, 1999; Undheim, 2009; Wilson et al., 2015; for review see Gerber, 2012; Swanson, 2012). Moreover, they have been shown to pose a risk for education, employment, and adult-age mental health; individuals with LDs have difficulties attaining educational degrees or high income levels (Hakkarainen, Holopainen, & Savolainen, 2015; McLaughlin, Speirs, & Shenassa, 2014; Raskind et al., 1999) and are more likely to have psychological problems than individuals without LD (e.g., Raskind et al., 1999; Wilson, Armstrong, Furrrie, & Walcot, 2009). Few longitudinal studies have extended beyond adolescence or early adulthood, and those conducted have mainly focused on RD. Therefore, knowledge on adult-age outcomes of MD or comorbid conditions (RD+MD) is more limited than on RD. Since LD refers to an array of learning disorders, we aim to enhance the existing knowledge on the adult-age impact of diverse types of LD (i.e., RD, MD, RD+MD). We scrutinize the associations between LD and adult-age outcomes using childhood clinical archived data merged with life-long follow-up register data on social benefits reimbursed on the basis of psychiatric diagnoses, educational degree after compulsory education, and unemployment allowances. Data on these outcomes from individuals with a history of LD are compared to data from a vast population based control group matched by age, gender, and place of residence when starting school.

Studies among children and adolescent have shown associations between mental health problems and LD (see Carroll, Maughan, Goodman, & Meltzer, 2005; Maughan & Carroll, 2006). Meta-analyses have indicated higher levels of depression (Maag & Reid, 2006; Nelson & Harwood, 2011a) and anxiety (Nelson & Harwood, 2011b). Although studies with adult samples are scarce, their findings are consistent with those conducted with child or adolescent samples (e.g., Carroll & Iles, 2006; Davis, Nida, Zlomke, & Nebel-Schwalm, 2009; Hoy et al., 1997; Raskind et al., 1999), and rates of adult internalizing disorders (anxiety, depression, sadness) have been found to be comparable to those found among children and adolescents (Davis et al., 2009; Klassen, Tze, & Hannok, 2011). However, most studies on mental health among adults have focused on RD (or LD without further specification); thus, less is known about possible differential outcomes of RD, MD, and RD+MD. Based on studies conducted among children, it appears that problems are more commonly exhibited by individuals with MD or RD+MD than those with RD or MD alone (Martínez & Semrud-Clikeman, 2004; Willcutt et al., 2013).

Mental health studies have commonly focused on *mean* level differences between LD and non-LD participants on symptom scales or ratings of psychological well-being. Therefore, the findings do not necessarily indicate whether participants with LD have higher rates of *clinical* disorders (see Maag & Reid, 2006). To our knowledge, the only recent large-scale study among adults was conducted by Wilson and colleagues (2009) using Canadian self-report survey data on mental health disorders among persons with or without LD. Indications of mental health problems were based on World Mental Health Composite Diagnostic Interview Schedule (WMH-CIDI; World Health Organization, 1990) and LD-status on self-reported LD diagnoses. The results indicated that persons with LD were two to five times more likely to report mental health problems (distress, depression, anxiety, suicidal thoughts, visit to mental health professionals, and poorer overall mental health) than persons

without LD. Problems were more prevalent among older (30–44 years) than younger (15–21 years) individuals with LD. However, a cross-sectional design and self-reports were used, and the differences between RD, MD, or RD+MD were not considered.

Knowledge about gender-related differences in the rates of mental health problems among individuals with LD is controversial. It is well known that women generally have higher rates of depression and anxiety disorders than men (Altemusa, Nilofar Sarvaiyac, & Epperson, 2014; Kessler, 2003), but LD studies have often overlooked gender (Nelson & Harwood, 2011a), or it was not found to be a statistically significant moderating factor (Martínez & Semrud-Clikeman, 2004; Nelson & Harwood, 2011b; Willcut et al., 2013). Some studies have found depressive symptoms and anxiety more prevalent in females with LD than males with LD or controls (Heath & Ross, 2000; Hoy et al., 1997; Nelson & Gregg, 2012). Contradictory findings have indicated that males with LD are more likely to have depressive episodes and anxiety disorders than females, while females are more likely to report high distress and suicidal thoughts (Wilson et al., 2009). It is, however, difficult to compare studies due to methodological differences, such as the samples and methods used to define mental health problems.

Along with mental health, educational level and employment influence one's potential for independent living and social functioning as an adult. Research has indicated that individuals with LD are at risk for low income (McLaughlin et al., 2014) and difficulties attaining high-level education (Hakkarainen et al., 2015; Haring, Lovett, & Smith, 1990; McLaughlin et al., 2014; Murray, Goldstein, Nourse, & Edgar, 2000; Raskind et al., 1999; Wilson et al., 2009). Also, findings reported in a recent *Education at a Glance* report (OECD, 2016) suggest associations between learning proficiency and educational attainment and employment: 17% of young adults (20–24 years) in OECD countries in 2015 were neither

employed nor in education (NEET), and their share was highest among those with lower skills in literacy, numeracy, and problem-solving skills.

Since the studies have often employed cross-sectional data, small samples, or focused on a single (or non-specified) deficit or restricted populations (e.g., college or university students), the results do not directly reveal the potential differential long-term effects of diverse types of diagnosed LD. However, there are some indications of differential effects of different types of LD on later education and employment. For instance, Fourqurean, Meisgeier, Swank, and Williams (1991) found that high math ability among high school students with LD was associated with later employment success. This is in line with more recent findings by Hakkarainen and colleagues (2015) suggesting that MD might have stronger association than RD with dropout from upper-secondary education. Similarly, gender-related differences in either education or employment have gained little attention. Hakkarainen et al. (2015) found no gender differences, but in McLaughlin et al.'s (2014) study, females with RD were more likely than males with RD to attain a high level of education, suggesting that RD may have more negative effects among males than females, but more research is needed.

To increase knowledge on the longitudinal impact of developmental LD, we explored adult-age mental health problems, education after compulsory education, and employment in groups with different types of LD (RD, MD, RD+MD) and controls without known history of LD using childhood clinical archived data merged with adult-age register data. The specific research questions were:

- (1) Is there an association between childhood LD and adult-age mental health problems:
 - a) Do individuals with a history of LD differ from controls in receiving sickness allowances or disability pensions on the basis of psychiatric diagnoses or in receiving reimbursements for psychoactive medication expenses?

- b) Do the three LD subgroups differ from each other in these outcome measures?
 - c) Are the possibly found associations retained after controlling for the effects of gender, age, and IQ, and are there gender-related differences between the groups?
- (2) Is there an association between childhood LD and not having further degree after compulsory education or unemployment?
- a) Do individuals with a history of LD differ from controls in not continuing education after compulsory education or in having received basic unemployment allowance for more than one year during their lives?
 - b) Do the three LD subgroups differ from each other in these outcome measures?
 - c) Are the possibly found associations retained after controlling for the effects of gender, age, and IQ, and are there gender-related differences between the groups?

Method

Procedure and participants

This study is part of a follow-up research tracing the lives of individuals with LD who attended the Clinic for Learning Disorders (CLD) in their childhood and have reached adult age (i.e., 20 years of age). The CLD is a public clinic upheld by the Niilo Mäki Institute and Jyväskylä City's Family Counseling Center, Finland. The CLD has served Central Finland since 1985, offering assessment and counseling for children (typically from 7 to 13 years of age) with specific LD, mainly referred by the Family Counseling Center's or school psychologists. There are no formal exclusionary criteria at the CLD, but children with primarily socio-emotional problems or global developmental delay are not referred to the CLD (see Närhi, 2002).

The childhood data used in the present study was drawn from the CLD's database. The register data for both the CLD clients ($n = 509$) and their matched controls ($n = 2,530$) were provided by the Population Register Center (PRC), Statistics Finland, and National

Social Insurance Institution (KELA) of Finland. KELA operates under the supervision of the Finnish parliament and looks after the basic security of Finland's residents. Its schemes cover areas of social security: family benefits, health insurance, unemployment security, pensions, disability benefits, rehabilitation, housing benefits, and financial aid for students (see <http://www.kela.fi/web/en>).

For the purposes of the present study, individuals over 20 years of age and available assessment data of reading and math performance were identified from the CLD database. Altogether, 517 individuals were identified, and PRC provided their contact information. Requested information could be found for 509 individuals; reasons for lacking data were either "disclosure of information is forbidden" or "living abroad." Next, the PRC identified five control individuals, matched by year of birth, gender, and place of residence at age 7 (i.e., beginning of compulsory education) for each individual of the clinical sample. All five control individuals could not be identified for five individuals. Thus, the final number of participants was 509 in the clinical sample and 2,530 in the population based control sample. Statistics Finland provided information on education and KELA provided register data concerning social benefits and reimbursements granted to these individuals. Ethical approval for the research was given by the University of Jyväskylä Ethical Committee.

It should be noted that the data are anonymous; individuals cannot be identified because register data with identifying information can only be provided with specific written informed consent. Parents had given informed consent to use the childhood data for research purposes when their child attended the CLD, but this does not cover requesting identifiable register data. Before merging the clinical data with the register data, the original data were converted to categorical variables in order to prevent identification. Individuals of the clinical data were classified into three LD subgroups (RD, MD, RD+MD) on the basis of having childhood reading and/or math test performance below or at -1.5 SD. Those performing in

both reading and math tests above -1.5 SDs ($n = 79$) and their controls ($n = 381$) were not included in the present study; thus, the final number of participants was 430 in the LD group and 2,149 in the control group (total $n = 2,579$). In the present study, all the following background variables were categorical: gender, LD group (RD, MD, RD+MD, control), age group (20–28 years, $n = 1,633$; 29–39 years, $n = 946$), and IQ level group (lower: Full Scale Intelligent Quotient based on WISC-R or WISC-III; Wechsler, 1974; 1991, $FSIQ < 85$, $n = 151$; higher: $FSIQ \geq 85$, $n = 272$). The score 85 was used as a cut-off score, because it is also the cut-off score for classification to Low Average range (16th percentile), i.e., 1 SD below the mean ($FSIQ=100$). It should be noted that IQ is not relevant for LD diagnosis or provision of special education in Finland.

Measures

The variables available for *both* the clinical sample and the control participants were gender, age group, sickness allowance or disability pension granted on the basis of psychiatric diagnoses (yes/no), reimbursements for psychoactive medication expenses (yes/no), educational degree after compulsory education (yes/no), and receiving unemployment allowance for over 258 days (yes/no). Additionally, information on the LD subtype (RD, MD, or RD+MD) and on FSIQ level (lower or higher) was available for the *clinical sample*. IQ data were missing for eight children.

Measures used to define LD. A child was classified as having RD and/or MD if his or her performance was at least -1.5 SDs below the mean of reference groups in reading or math tests. Tests used have varied over the years at the CLD; thus, the definitions of RD and MD were based on the tests in use at the time the child attended the CLD.

Reading measures. RD was defined primarily on the basis of *reading fluency*, since in orthographically transparent languages, like Finnish, children achieve accurate reading skills in the first grade, after which reading disability is manifested mostly as dysfluency

(Aro, 2004). Measures used at the CLD were text or word-list reading tests developed and normed in Finland. The *Misku-Text* (Niilo Mäki Institute, 1992–2004) is a text-reading task normed for 8–12-year-old children, in which the child is to read aloud a short story as fluently and correctly as possible. The *Ärps* (Niilo Mäki Institute, 1992–2004) is a word- and pseudo-word reading test normed for grades 2 to 4. The *Markkinat Word List* (Niilo Mäki Institute, 1992–2004), also normed for 8–12-year-old children, comprises 13 words which the child is to read aloud as fluently and accurately as possible. In these tests, the time taken to complete the task is compared to the average performance of a reference group. The *Lukilasse* (Häyrynen, Serenius-Sirve, & Korkman, 1999) is a reading, spelling, and mathematical skills test battery normed for grades 1 to 6. In the *Word Reading Subtest*, the child reads aloud a list of words, which gradually become longer and more difficult. The fluency score is obtained by calculating the correctly read words within two minutes.

Math measures. MD definition was based on the following tests used at the CLD over the years: The *Kaufman Assessment Battery for Children – Arithmetic Subtest* (K-ABC; Kaufman & Kaufman, 1982) includes 38 tasks measuring the child’s ability to identify numbers and understand mathematical concepts, and to count and compute. Local norms are available for grades 2 to 5 (Niilo Mäki Institute, 1992–2004). In the *RMAT* (Räsänen, 1992; normed for grades 3 to 6), the child is requested to perform as many basic arithmetical operations (max. 55) as possible in 10 minutes. The *Lukilasse Arithmetics Subtest* (Häyrynen et al., 1999) consists of basic arithmetic operation tasks normed for grades 1 to 6.

Measures of adult-age mental health, education, and employment. Two types of information derived from the register data were used as indicators of mental health problems: having received reimbursement from KELA for (1) sickness leave or disability pension, or for (2) anxiolytics (WHOCC-ATC/DDD Index: N05B) or antidepressants (N06A). Both types of reimbursements require psychiatric diagnoses.

Sickness allowance and disability pension. A person can apply for a sickness allowance from KELA as compensation for loss of income due to incapacity to work. It is available after 10 working days of the onset of the illness, and is payable for 300 working days. If the illness or disability becomes persistent and prevents a person from earning a reasonable living, one can apply for a disability pension. In the present study, benefits granted on the basis of following psychiatric diagnoses were used: depressive mood disorders (ICD-10 codes F30-39); disorders of adult personality and behavior (F60-69); behavioral and emotional disorders with onset usually occurring in childhood and adolescence (F90-98); mental and behavioral disorders due to psychoactive substance use (F10-19); anxiety and stress-related mental disorders (F40-48); eating disorder (F50); schizophrenia, delusional, and other non-mood psychotic disorders (F20-29). Few individuals had more than one diagnosis as the reason for sickness allowance or disability pension: in the control group 22 (1.0 %), in RD 4 (3.1%), in MD 1 (0.9%), and in RD+MD 3 (1.6%) individuals.

Reimbursement for expenses caused by psychoactive medication. A person can be reimbursed for prescriptions for the treatment of an illness if the product is confirmed as reimbursable by the Pharmaceuticals Pricing Board (Ministry of Social Affairs and Health). In the present study, we included reimbursements for anxiolytics and antidepressants.

Degree after compulsory education. Information provided by Statistics Finland on the highest educational degree at the time of data gathering was used as an indication of whether the person had continued schooling after compulsory education (i.e., grade 9). Those still in school or dropouts were classified as not having education after compulsory schooling. Since, in Finland, compulsory education lasts up to 16 years of age, and both upper secondary and vocational school lasts three additional years, all participants could have attained the next educational degree by the age of 19. It is plausible that some of the participants without a degree according to the register data had repeated a year during their compulsory education

or had changed their trade in vocational school and were therefore taking longer to gain their first degree after compulsory education.

Basic unemployment allowance. Basic unemployment allowance is paid by KELA for unemployed persons who have been employed for at least six months during the two years preceding unemployment. However, those belonging to *an unemployment fund* are first reimbursed from their fund before receiving the allowance from KELA. To qualify for membership of an unemployment fund, a person must be an employee or self-employed. Employment history and age determine the maximum payment period from the unemployment fund, varying between 300–500 working days (based on 258 working days/year). After this period, or if a person does not belong to any fund, KELA pays basic unemployment allowance for a maximum of 500 working days. In this report, participants were categorized as having received either fewer or more than 258 days of unemployment allowance. Data of unemployment fund payments were not available; thus, our unemployment rate estimation is assumed to be a rather conservative approximation.

Data Analysis

To compare control and LD groups, the following two analyses were conducted separately for each outcome variable. First, cross-tabulation and χ^2 -test were used to analyze whether the proportions of subjects in the categories of each outcome measure was dependent on the LD status (control vs. LD). Second, logistic stepwise regression analysis was performed to analyze whether the LD status (entered at Step 3) had a significant effect after controlling for the effect of gender (Step 1) and age group (Step 2). As Step 4, the interaction term LD status \times gender was entered to see whether the effects of LD differed between males and females. Interactions are only reported if significant, and if so, additional logistic regression analyses were conducted separately for males and females.

Three analyses were performed to compare the LD subgroups. First, cross-tabulation and χ^2 -test were used to analyze whether the proportions of subjects in the categories of each outcome measure was dependent on the LD subgroup (RD, MD, RD+MD). Second, logistic stepwise regression was used to contrast single deficit subgroups against the comorbid subgroup (i.e., RD against RD+MD and MD against RD+MD). In these models, IQ-level grouping was entered as Step 3 after gender (Step 1) and age group (Step 2). Subgroup was entered at Step 4, and the last term entered was subgroup \times gender (Step 5). Third, logistic regression analysis as above was conducted contrasting the single deficit subgroups against each other (i.e., RD against MD). In case of significant subgroup \times gender interaction effects, additional logistic regression analyses were conducted separately for males and females.

Results

The LD sample had attended the CLD at varying ages (range: 6.5–15.5 years; median: 10 years, 3 months), and they were born between 1970 and 1994. Table 1 shows the number of individuals in the control and LD groups, and in the LD subgroups by gender and age group. No differences between the groups (control vs. LD; RD vs. MD vs. RD+MD) were found in gender or age grouping. Cross-tabulation revealed that the LD subgroups were not evenly distributed in the IQ-level groups ($\chi^2(2) = 30.87; p = .000$). More individuals than expected were in RD with $IQ \geq 85$ (83.7%; Adjusted Residual (AdjR) = 5.5) and less than expected in MD (53.6 %; AdjR = -2.8) and RD+MD subgroups (57.1%; AdjR = -2.7). Therefore, IQ was controlled for in analyses concerning LD subgroups.

Mental Health: Sickness Allowance and Disability Pension

LD vs. control. Cross-tabulation revealed that sickness allowance and disability pension granted on the basis of psychiatric diagnoses were more common among individuals with LD than among the control group (see Table 2). The logistic regression analysis indicated that gender and age made a significant contribution (see Table 3): females more

probably received these payments, and the probability of receiving them increased with age. LD status contributed significantly after controlling for the effect of gender and age.

Subgroup comparisons. No significant differences were detected between the LD subgroups (see Table 2). The only significant effect detected in all logistic regression analysis concerned age: older age-group was more probably receiving sickness allowance and disability pension than the younger age-group (see Table 3).

Mental Health: Reimbursements for Psychoactive Medicine

LD vs. control: anxiolytics and antidepressants. The cross-tabulation indicated that the share of individuals reimbursed for anxiolytics and antidepressants was greater in the LD group than in the control group (see Table 2). The logistic regression analysis (see Table 3) indicated that females were more probably reimbursed for both and the probability of having been reimbursed for them increased with age. Even after controlling for the effects of gender and age, LD status contributed significantly to the prediction for reimbursements for *anxiolytics*. A significant gender \times LD status interaction emerged for *antidepressants*; thus, additional logistic regression analyses were conducted separately for males and females.

The percentage of the *males* with LD reimbursed for antidepressants was 16.3 %, and for the males in the control group the percentages was 13.8 % (see Table 4). The respective percentages among *females* were 31.8 % and 17.7 %. The logistic regression analysis for *males* indicated that the probability of reimbursement for antidepressants increased with age, but LD did not contribute significantly while among *females*, the probability did not increase with age, but LD did contribute significantly

Subgroup comparisons: anxiolytics. No significant differences were detected for anxiolytics between the LD subgroups (see Table 2). Significant effects for age (older more probably reimbursed) were detected in all analyses, and a significant effect of IQ group

(lower IQ group more probably reimbursed) emerged in the analyses contrasting single deficit (RD or MD) and comorbid subgroups (RD+MD; see Table 3).

Subgroup comparisons: antidepressants. Cross-tabulation showed that reimbursements for *antidepressants* were more common than expected in MD (see Table 2; $\text{AdjR} = 2.5$), being almost twice as common in MD (29.2%) as in RD (16.5%). The logistic regression analysis indicated significant effects for gender (females more probably reimbursed), age (older more probably reimbursed), and IQ group (lower IQ group more probably reimbursed; see Table 3). A significant gender \times subgroup interaction emerged, indicating gender-related differences between RD and RD+MD (Wald = 8.49, $p = .004$, $\beta = -2.04$, $\text{Exp}(\beta) = .130$), whereas MD did not differ from RD+MD. Because of the interaction effect, logistic regression analyses were conducted separately for males and females, including only RD and RD+MD subgroups (see Table 4).

Among *males*, the probability of reimbursement for antidepressants increased with age and with belonging to the lower IQ group, and was higher among males with RD (17.9 %) than those with RD+MD (12.1 %; see Table 4). Among *females*, age or IQ-group did not contribute significantly. However, since there were only six females with lower IQ in RD, the analysis was conducted excluding IQ from the equation. This analysis indicated significant differences between the subgroups: Females with RD (13.2 %) were less probable to have been reimbursed for antidepressants than females with RD+MD (40.9 %), after controlling for the non-significant effect of age.

The logistic regression analyses contrasting RD and MD indicated that only age contributed significantly (see Table 3). When the non-significant IQ group was removed from the equation, a significant subgroup effect was detected (Wald = 4.83, $p = .028$, $\beta = .70$, $\text{Exp}(\beta) = 2.02$): MD were more probably reimbursed for antidepressants than RD.

Degree after compulsory education

LD vs. control. Cross-tabulations indicated that *not* having a degree after compulsory education was significantly more common among the LD group than the control group (see Table 2). The logistic regression analysis indicated significant effects for age (older more probable to have a further degree) and for LD status (see Table 3).

Subgroup comparisons. The cross-tabulation revealed no differences between the LD subgroups (see Table 2). The logistic regression analysis contrasting RD and MD with RD+MD indicated significant contributions of IQ group: those belonging to the higher IQ group were more probably continuing their education (see Table 3). After controlling for these effects, RD or MD did not differ from RD+MD, but a significant subgroup \times gender interaction emerged, indicating gender-related differences between RD and RD+MD ($Wald = 5.12, p = .024, \beta = 1.50, \text{Exp}(\beta) = 4.47$). No differences emerged between MD and RD+MD. Because of the interaction, the logistic regression analyses were conducted separately for males and females, including only RD and RD+MD subgroups.

Among *males*, IQ and subgroup contributed significantly (Table 4); those with higher IQ were more probable to have attained a degree, and males with RD (31.6 % with no degree) were less probable to have attained a degree than males with RD+MD (24.3 %). Among *females*, only age contributed significantly, with older more probable to have attained a degree (see Table 4). When the non-significant IQ was not in the equation, a significant difference was detected between RD and RD+MD, indicating that females with RD+MD were less probable (31.8 %) to have attained a degree than females with RD (13.2 %).

The logistic regression analysis contrasting RD and MD indicated a significant effect for gender (females more probable to have attained a degree), IQ (higher IQ group more probable), and for gender \times subgroup interaction. The logistic regression analyses for *males* indicated that only IQ contributed significantly to having attained a degree (see Table 4). The logistic regression model for *females* indicated that age contributed significantly with

older more probable to have attained a degree (Table 4). The model without IQ indicated that females with MD were more probable (36.2 %) not to have continued education than females with RD (13.2 %).

Unemployment Allowance

LD vs. control. Cross-tabulations indicated that the percentage of individuals who received unemployment allowance from KELA for over 258 days was higher than expected in the LD group and lower than expected in the control group (see Table 2). The logistic regression showed a significant effect of age (older more probable) and for LD status.

Subgroup comparisons. Cross-tabulation revealed a significant difference between the LD subgroups (see Table 2): individuals in RD (19.5% AdjR = -2.6) were less probable than expected to have been unemployed for more than 258 days. The logistic regression analysis contrasting RD and MD with RD+MD indicated a significant effect for age (older more probable to have been unemployed; see Table 3). Neither RD nor MD differed from RD+MD after controlling for the effects of gender, age, and IQ.

When RD and MD were contrasted, a significant effect was detected for age (older more probable to have been unemployed) and subgroup: individuals with MD were more probable to have been unemployed for over 258 days than individuals with RD.

Discussion

The purpose of the present study was to gain a deeper understanding about adult-age (20 to 39 years) mental health, education, and employment of individuals with history of learning LD, by merging register data with measures drawn from childhood archived data from a clinic for LD. The adult-age outcomes of individuals with a history of LD were compared to a large matched control group with no known history of LD. Within the LD group, three subgroups (i.e., RD, MD, and comorbid condition [RD+MD]), were compared.

Two main findings emerged. First, all measures indicated less favorable outcomes among the LD group than among the control group, suggesting that a notable share of individuals with LD have problems with mental health, are unable or delayed in attaining degrees after compulsory education, and have difficulties gaining (or keeping) employment. Second, LD subgroup differences were found: MD was more strongly associated with antidepressant use and unemployment than RD. Moreover, gender-related subgroup differences emerged, indicating that RD was a more prominent risk for males, while for females, MD with or without RD resulted more often than RD in the use of antidepressants and the lack of a secondary degree.

Our first research question concerned association between childhood LD and adult-age mental health problems, and possible differences between the LD subtypes. All our indicators of mental health problems; i.e., having received sickness allowances or disability pensions on the basis of psychiatric diagnoses and having received reimbursements for psychoactive medication expenses, indicated more problems among the group with childhood LD diagnosis than among the population based reference group.

The higher percentage of individuals receiving sickness allowances or disability pensions indicates that mental health problems were a more common reason for incapacity to work among the LD group than the controls. Mental and behavioral disorders have been the largest reason for earnings-related disability pensions in Finland since 2000 (Statistics Finland: <http://www.findikaattori.fi/en/76>), but no earlier studies exist on the share of persons with LDs. Present results suggest that childhood LD increase the risk for temporal or persistent incapacity to work due to mental health problems, and advocate the need for studies focusing on the developmental mechanisms leading to these unfavorable outcomes.

Individuals with LD were also more commonly reimbursed for both anxiolytics and antidepressants than control individuals. This is in accordance with earlier studies showing

high rates of anxiety and depression among individuals with LD (Maag & Reid, 2006; Wilson et al., 2009). In the survey study by Wilson and colleagues (2009), percentages of LD individuals with depression were of the same magnitude (22–29 years: 21%; 30–44 years: 36%) as the use of antidepressants in our study. However, in our LD sample, anxiolytics were not reimbursed to the same extent as their LD subjects reported anxiety (22–29 years: 27%; 30–44 years: 31%). Perhaps this is because our estimate is based on reimbursements for medication instead of self-reports. Considering that the prevalence of diseases cannot be determined merely on the basis of medication reimbursements as in our data, and bearing in mind that all existing studies have used different methods to define mental health problems, the findings are in accordance: they reflect the elevated share of clinical depression and anxiety among individuals with LD. Since these diseases presumably influence life satisfaction and the capacity to study and work, the findings imply a need for pedagogical and preventive programs comprising elements supporting psychological well-being in both primary and secondary education.

In general, females were more probably reimbursed for psychoactive medication, which is in accordance with earlier studies showing a higher prevalence of depression and anxiety among females (e.g., Kessler, 2003). Our findings indicating that females with LD were more often reimbursed for antidepressants than control females is also in accordance with earlier studies on depression among females with LD (e.g., Heath & Ross, 2000). A higher prevalence of depression among females has been attributed to, for example, women's tendency to derive their self-worth from interpersonal relationships (Kendler & Gardner, 2014), hyper-responsiveness to stress experiences (Nolen-Hoeksema, 2001), and girls' tendencies to feel more guilt, self-blame, and feelings of failure (Bennett, Ambrosini, Kudes, Metz, & Rabinovich, 2005). It has also been speculated that girls may carry risk factors for depression (Nolen-Hoeksema & Girgus, 1994). This concern is supported by our finding

showing that age did not significantly influence the probability of females being reimbursed for antidepressants, i.e., these medications were already in use at a young age. This suggests that girls may have vulnerability for stress, thoughts, and emotions induced by LD already as teen-agers.

Use of antidepressants was especially high among individuals with childhood MD (30%), which together with high rate of unemployment among MD (30%) and RD+MD (33%), raise a general concern for individuals with MD. However, our subgroup comparisons showed that reimbursements for antidepressants were markedly more common among females with RD+MD (41%) than females with RD (13%), while among males, contrary proportions were detected showing higher percentage among males with RD (18%) than with RD+MD (12%). This suggests that LD subtypes may be differentially related with depression among females and males. Thus, our findings on antidepressants evoke the concern that LD may pose a risk for depression, especially among girls with RD+MD and boys with RD.

Our second research question concerned associations between childhood LD and lack of education and unemployment, and possible differences between the LD subtypes. The analyses indicated that the percentage of individuals with LD *not* attaining a degree after compulsory education by the time of the gathering of the register data (i.e., at least 20 years of age) was more than twice that of the controls. This finding may reflect slower progress in education or higher drop-out rate among the LD group. This is especially distressing since earlier studies showed that low education is associated with, for example, adult-age socioeconomic status (SES) and life stressors among individuals with LD (Raskind et al., 1999), and, more generally, increases the risk for marginalization (see Paananen & Gissler, 2012). Moreover, our subgroup comparisons showed that attaining a degree after compulsory education was affected by age among females, but not among males, suggesting that females with LD may be more prone to continue their education at an older age than males with LD.

The concern for males was also raised in the *Education at a Glance* report (OECD, 2016), indicating that the share of NEET in Finland has been increasing particularly among males. Also, although not the main focus of the present study, IQ level seemed to have an effect on education among males. It should be noted, however, that there was a small number of females with a lower IQ level in the RD subgroup. Although tentative, our findings on possible differential effects of gender and age on attained educational level advocate the need to consider these factors in future studies.

Interaction effects emerged between LD subgroup and gender also concerning education. Similarly with the gender-related subgroup differences concerning antidepressants, RD+MD and MD (32% and 36%) were more strongly associated than RD (13%) with not attaining a secondary degree among females. Whereas, males with RD were less probable (32%) to have continued education than males with RD+MD (24%) although percentages were very high among both groups of males. These results agree with those of McLaughlin and colleagues (2014), showing that females with RD were more likely than males with RD to attain a high level education. When our findings on use of antidepressants and lack of education are considered together, they suggest that MD (with or without RD) may pose a higher risk than RD for females, whereas RD seemed to pose a risk for males.

The finding showing that males with RD were somewhat less probable to continue schooling after compulsory education compared to males with RD+MD was surprising. The reason for this finding can only be speculated: it can be a reference bias or related to differential support provided at school for these subgroups. One possible explanation could be related childhood comorbidity of socio-emotional problems. Our post-hoc analyses indicated that having several comorbid socio-emotional problems in childhood (i.e., internalizing, externalizing, and attentional problems) was more common among males without degree after compulsory school in the RD group (17 %) than in RD+MD group (3

%). It should also be noted that some of the individuals without a degree have not necessarily dropped-out of education, but may be delayed in their studies compared to their peers.

However, this question requires further research. In sum, our findings advocate the need for further studies on the differential influence of LD subtypes for females and males as risk factors, especially for depression and lack or delay in education.

Our analyses concerning unemployment indicated that the percentage of individuals who received unemployment allowances from KELA for more than a year during their lives was significantly higher among the LD group (28%) than among the control group (18%). And, the subgroup comparisons indicated that, in general, MD was associated with unemployment (30%), whereas the RD group showed the least problems with employment (20%). This is in line with Hakkarainen and colleagues' (2015) findings indicating an association between MD and school drop-out. Caution should be used when interpreting this finding, since we did not have access to unemployment allowances granted by unemployment funds; thus, our unemployment estimate is presumably conservative and modest. However, the high percentage of individuals lacking a further educational degree and the high proportion with employment problems imply that guidance to find proper strategies to succeed in education and services supporting the search for one's vocational path should be available in vocational institutions. These services are needed by a noticeable number of individuals with LD after leaving compulsory education and even after entering the workforce.

Interpreting follow-up studies of LD is complicated by methodological limitations caused by, for example, lack of control group, attrition, changes in LD definitions over time, and group designs limiting conclusions on an individual level (see Gerber, 2012). Our study is not immune to some of these and other limitations, but its strength is its large control group of over 2,000 subjects and no attrition of the individuals from the original clinical data.

Although the tests used to classify children with LD differed over the years at the clinic, it can be claimed that the LD sample represents children with rather severe LD. Their learning problems were evident well before they attended the clinic where they were referred by a psychologist. It should also be noted that the control group was a population based sample. Thus, it is probable that LDs were as prevalent among them as in population in general. An obvious limitation is the categorical nature of the childhood data. Detailed individual neuropsychological and socio-emotional assessment data from childhood would have yielded a richer picture and allowed for analysis of predictive associations between childhood characteristics and adult-age outcomes. At present, we cannot explain the phenomena or indicate factors contributing to a higher risk for mental health problems. Furthermore, it should also be noted that the participants of the LD group were all referred to the clinic due to their learning problems; thus, those with *primarily* socio-emotional problems with comorbid LD are under-represented in the data. Since it is known that LD often co-occurs with socio-emotional problems (e.g., Arnold et al., 2005), our findings on mental health problems are probably conservative, i.e., presumably, a higher incidence of problems would have been found if children with LD and comorbid behavioral and emotional problems were included.

The childhood data was clinical data; therefore, such factors as IQ level, size of the subgroups, or age and gender distribution could not be controlled for. Also, other limitations related to possible reference bias must be considered when generalizing the findings. Furthermore, we cannot discern the effects of the assessment and consultation process incorporated in the clinic's procedures. It can only be surmised that psychological problems might be even more common among individuals who have not been diagnosed in childhood and who have not received consultation.

Although a study such as the present one does not allow for ascertaining the prevalence of mental disorders, the high percentages of individuals using psychoactive

medication, discontinuing or delaying their education, or having problems with employment suggest that researchers and clinicians as well as those involved in adult education need to consider mental health and educational problems among individuals with LD. The findings suggest that strategies and personal attributes aimed at circumventing difficulties should be a priority in special education early on, and they should be given at least equal attention as efforts to enhance academic skills. Earlier research suggests that certain interpersonal factors, such as community and social support (e.g., Miller, 2002; Panicker & Chelliah, 2016; Raskind et al., 1999) and intrapersonal factors, such as self-awareness, proactivity, self-esteem, perseverance, and effective coping strategies (e.g., Gardynik & McDonald, 2005; Idan & Margalit, 2014; Miller, 2002; Raskind et al., 1999; Spekman, Goldberg, & Herman, 1993; Werner, 1993) are relevant predictors of coping with LD and they predict success better than variables like IQ, academic achievement, life stressors, age, gender, SES, and ethnicity (Raskind et al., 1999). When these “success attributes” are understood as a set of skills which can be rehearsed and learned, rather than specific or stable individual characteristics, it opens new horizons and prospects for developing supportive programs or therapeutic approaches to enhance psychological well-being in, for example, special education settings or psychotherapeutic relationships.

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Table 1

Number of Individuals in Each Group by Gender, Age Group, and IQ-level group, and Mother's Educational Level in Each Group.

	Control		LD Subgroup						Total	
	Male	Female	RD		MD		RD+MD		Male	Female
			Male	Female	Male	Female	Male	Female		
	1506	643	95	38	66	47	140	44	1807	772
Age-group										
20-28	911	450	61	27	42	32	79	31	1093	540
29-39	595	193	34	11	24	15	61	13	714	232
IQ-level group										
<85	n.a.	n.a.	15	6	33	22	56	19	n.a.	n.a.
≥85	n.a.	n.a.	77	31	33	20	84	27	n.a.	n.a.
Total (%)	2149 (83.3)		133 (5.2)		113 (4.4)		184 (7.1)		2579	
Mother's education^{*)}										
M (SD)	2.01 (.77)		1.92 (.70)		1.97 (.76)		1.84 (.62)		1.99 (.75)	

Note: ^{*)} Mother's educational degree was used as a proxy of SES. Four categories used were: 1= comprehensive school or unspecified; 2= high school, vocational school; 3 = polytechnic, college; 4 = university degree (master or higher); in all groups median = 2; min = 1, and max = 4.

Table 2

Percentage of Individuals who Received Sickness Allowances/Disability Pensions, Reimbursement for Psychoactive Medication, No Education after Compulsory Education, or Received Unemployment Allowance for Over 258 Days in the Control and LD Groups, and in the LD Subgroups

	Group				LD subgroups			
	Control	LD	AdjR	$\chi^2(1)$	RD	MD	RD+MD	$\chi^2(2)$
Mental health								
Sickness allow./								
Disab. pension	7.1	10.0	2.1	4.39*	12.0	8.0	9.8	1.14
Anxiolytics	7.1	11.4	3.0	9.07**	9.8	14.2	10.9	1.25
Antidepressants	15.0	20.9	3.1	9.44**	16.5	29.2	19.0	6.63 ^{a)}
Compulsory education only								
	12.8	27.2	8.2	57.25***	26.3	30.1	26.1	.64
Unemployed over 258 days								
	18.3	27.9	4.6	20.81***	19.5	30.1	32.6	6.9 ^{a)}

Note. *** $p < .001$; ** $p < .01$; * $p < .05$; ^{a)} See AdjRs for subgroups in text.

Table 3

Results of the Stepwise Logistic Regression Analyses Contrasting: 1) LD Group against Control Group; 2) Both RD and MD against RD+MD; and 3) RD against MD

Outcome measure	LD vs Control		RD & MD vs RD+MD		RD vs MD	
	Wald	β /Exp(β)	Wald	β /Exp(β)	Wald	β /Exp(β)
Sickn. allow. & dis. pension						
Gender	5.43*	.37/1.45	2.14	.51/1.66	.24	.22/1.25
Age-group	37.67***	.93/2.54	7.90**	.92/2.51	7.28**	1.18/3.25
IQ-group ^{a)}	-	-	2.76	-.58/.56	.09	.15/1.17
Group	4.39*	.38/1.47	2.83		1.02	-.48/.62
Reimburs. for anxiolytics						
Gender	5.44*	.36/1.44	3.54	.61/1.84	.20	.19/1.21
Age-group	12.35***	.52/1.69	6.88**	.82/2.27	5.85*	.98/2.66
IQ-group ^{a)}	-	-	3.91*	-.64/.53	.09	-.13/.88
Group	8.94**	.52/1.68	.37		.63	.34/1.41
Reimburs. for antidepressants						
Gender	7.70**	.36/1.43	16.55***	1.72/5.59	1.10	.35/1.42
Age-group	27.58***	.58/1.78	12.33***	.91/2.48	7.425**	.88/2.41
IQ-group ^{a)}	-	-	4.13*	-.54/.58	1.07	-.36/.70
Group	1.26	.20/1.22	5.10		2.46 ^{c)}	.53/1.71
Gender×Group ^{b)}	4.42*	.59/1.80	8.59*			
Compulsory education only						
Gender	.51	.09/1.09	.68	-.32/.72	4.83*	1.18/3.24
Age-group	9.31**	.37/1.44	1.71	.31/1.36	1.28	.36/1.43
IQ-group ^{a)}	-	-	11.09**	.79/2.21	5.43*	.77/2.15
Group	54.73***	-.94/.39	4.46		2.54	.82/1.86
Gender×Group ^{b)}	-	-	6.86*		5.97*	-1.68/1.19
Unemployment (>258 days)						
Gender	.15	.04/1.05	3.31	.45/1.56	.00	.02/1.02
Age-group	91.12***	.97/2.64	19.18***	.99/2.70	20.80***	1.45/4.28
IQ-group ^{a)}	-	-	.07	-.06/.94	1.71	.49/1.63
Group	21.16***	.57/1.77	4.88		4.85*	.75/2.12

*Note: *** $p < .001$; ** $p < .01$; * $p < .05$; ^{a)}IQ used only in the analyses concerning LD subgroups; ^{b)} See Table 4 for analyses concerning the interaction effects; ^{c)} See text for analyses without IQ in the equation.*

Table 4

Interaction Effects: Results of the Stepwise Logistic Regression Analyses Separately for Males and Females Contrasting: 1) LD Group against Control Group; 2) RD against RD+MD; and 3) RD against MD

Outcome measure	LD vs Control		RD vs RD+MD		RD vs MD	
	Wald	β /Exp(β)	Wald	β /Exp(β)	Wald	β /Exp(β)
Reimburs. for antidepressants						
<i>Males</i>						
Percentage.	16.3/LD	13.8/Contr.	17.9/RD	12.1/RD+MD		
Age-group	31.65***	.72/2.15	6.25**	.97/2.64		
IQ-group ^{a)}			4.23*	-.86/.42		
Group	1.27	.20/1.22	4.01*	.82/2.27		
<i>Females</i>						
Percentage	31.8/LD	17.7/Contr.	13.2/RD	40.9/RD+MD		
Age-group	1.31	.21/1.23	1.58	.70/2.01		
Group	12.81***	.77/2.16	7.20**	-1.55/.21		
Compulsory education only						
<i>Males</i>						
Percentage			31.6/RD	24.3/RD+MD	31.6/RD	25.8/MD
Age-group			1.27	-.35/.71	.00	-.02/.98
IQ-group ^{a)}			8.22**	.95/2.59	7.05*	1.11 /3.02
Group			4.70*	-.70/.50	3.40	.76/2.14
<i>Females</i>						
Percentage			13.2/RD	31.8/RD+MD	13.2/RD	36.2/MD
Age-group			3..90*	1.60/4.91	4.21*	.69/4.16
Group			4.03*	1.19/3.30	5.95*	1.42/4.15

*Note: *** $p < .001$; ** $p < .01$; * $p < .05$; ^{a)} IQ used only in the analyses concerning males LD subgroups; due to small number of females in lower IQ group the LD subgroup effect for them was analyzed without non-significant IQ in the equation.*