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Health, lifestyle habits, and physical fitness among adults with ADHD compared with a random sample of a Swedish general population

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ABSTRACT

Background: Persons with Attention Deficit Hyperactive Disorder (ADHD) represent a high-risk population according to health and lifestyles. In the present study, 48 adults with ADHD were recruited to a forthcoming lifestyle intervention. The ADHD sample was matched to a random sample of 42 persons from a Swedish general population that was selected from LIV (a Lifestyle-Performance-Health project). **Objective**: To identify potential differences in health, lifestyle habits, and physical fitness between adults with and without ADHD. **Method**: Self-reported questionnaires and physical fitness tests. **Results**: The ADHD group show worse health outcomes with higher odds ratios for bad general health (OR;13 CI; (3,4–50)), and poorer lifestyle habits with higher odds ratios for low weekly exercise (OR; 3,8 CI; (1,2–13)). When adjusting for education, employment status, and cash margin, the ADHD sample did not show decreased aerobic fitness (OR; 0,9 CI; (0,8–1,0), but lower odds ratios for doing less sit-ups (OR; 0,6 CI; (0,4–0,9)) compared to the general population group. **Conclusion**: It is not possible to prove that the ADHD diagnosis itself cause the worse health and lifestyle. Other lifestyle factors may have negative consequences of adult ADHD, such as lower levels of education, less succeed in working life, and minor financial margins.

KEYWORDS
Adult ADHD; general health; lifestyle habits; mental health; fitness test; Swedish general population

Introduction

Attention-deficit/hyperactivity disorder (ADHD) is a common clinical condition defined by impulsive, hyperactive, and inattentive behaviour (American Psychiatric Association, 2013). The prevalence of ADHD is 5% of all children and adolescents and 2.5% of all adults worldwide (Faraone et al., 2015). The prevalence of ADHD in Europe is estimated at 1% to 8% (Kessler, Lane, Stang, & Van Brunt, 2009; Ramos-Quiroga, Montoya, Kutzelnigg, Deberdt, & Sobanski, 2013), depending on the sample, the diagnostic criteria, and the data collection method. However, ADHD is no longer classified as a childhood disorder but rather as a chronic lifelong disorder and carries into adulthood but lessens over time (Faraone, Biederman, & Mick, 2006).

There is a strong correlation between mental illness and chronical physical disease (Scott et al., 2016). ADHD is associated with an increased health risk and high morbidity and mortality (Spencer, Faraone, Tarko, McDermott, & Biederman, 2014). Comorbidity in persons with ADHD are directly associated with lifestyle habits (Weissenberger et al., 2017). ADHD contribute to difficulties in living a healthy life (Nigg, 2013; Weissenberger et al., 2018).

Many adults with ADHD suffer from executive dysfunction (e.g. difficulties maintaining attention and insufficient working memory) (Adler et al., 2017). Due to cognitive impairments it is more challenging to focus and organize daily tasks and routines. Motivation impairments may also affect the possibility of maintaining a healthy lifestyle, such as through physical activities, etc. (Quesada, Ahmed, Fennie, Gollub, & Ibrahimou, 2018). For many adults with ADHD, executive dysfunction (e.g. difficulties maintaining attention and insufficient working memory) affects many areas of daily functioning (Adler et al., 2017; Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005); e.g. failure in education, work and social relationships, economic problems, and experiences of loneliness (Fredriksen et al., 2014; Russell, Ford, Rosenberg, & Kelly, 2014).

Adults with ADHD are associated with higher levels of stress (Hirvikoski, Lindholm, Nordenstrom, Nordstrom, & Lajic, 2009), which can be aggravated by social, emotional, and psychological problems (Biederman et al., 2012). Adults with ADHD report low life satisfaction and low self-esteem because of poor academic achievements level, followed by high risk of unemployment (Fayyad et al., 2016; Simon, Czobor, Bálint, Mészáros, & Bitter, 2009) and frequently missed work on sick leave (Kessler et al., 2009). This is problematic because low socioeconomic status is found to be associated with several

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negative health outcomes, including poor mental health (Ewart et al., 2017).

ADHD is an underestimated, under-recognized, and undertreated diagnosis (Kessler et al., 2009; Ramos-Quiroga et al., 2013), and many adults with ADHD are diagnosed late in life and receive psychiatric care for poor mental health before the diagnosis is established (Deberdt et al., 2015). ADHD is strongly associated with an increased risk of comorbid psychiatric disorders (Hesson & Fowler, 2015; Kooij et al., 2012; Matthies, Sadohara-Bannwarth, Lehnhart, Schulte-Maeter, & Philipsen, 2016; Solberg et al., 2018). Mood disorders and anxiety disorders are common in both men and women across all age groups (Biederman & Faraone, 2006; Fayyad et al., 2016). Adult ADHD is also associated with sleep problems, especially insomnia (Brevik et al., 2017), which are well-known risk factors for increased risk of somatic health problems: e.g. being overweight, developing Type 2 diabetes or cardiovascular disease, and premature death in the general population (Clark et al., 2016; Ikehara et al., 2009; Medic, Wille, & Hemels, 2017).

In a population study, Ptacek et al. (2016) found that higher symptoms of ADHD had higher rates of unhealthy lifestyles and may contribute to unhealthy lifestyle habits such as substance abuse, alcohol use, smoking, unhealthy diets, and sedentary lifestyles (Daurio et al., 2018; Kjaer, Jakobsen, Lasgaard, & Munk-Jørgensen, 2017; Rhodes et al., 2016; Suchert, Pedersen, Hanewinkel, & Isensee, 2017; Weissenberger et al., 2018). High body mass index (BMI) and obesity are also more common among adults with ADHD compared to those without the disorder (Cortese & Tessari, 2017; Nigg, 2013; Nigg et al., 2016; Cortese et al., 2016). Studies of physical fitness and physical activity in adults with ADHD are limited. Physical activity is described in several studies to be related with improved cognitive and behavioural functions, as well as self-perceived health (Abramovitch, Goldzweig, & Schweiger, 2013; Den Heijer et al., 2017; Fritz & O'Connor, 2016; Gapin, Labban, & Etnier, 2011; Kantomaa, Tammelin, Ebeling, Stamatakis, & Taanila, 2015). A Korean study by Jeoung (2014) explored the relationship between ADHD and physical fitness and found a close relationship between low muscular strength and endurance and abdominal obesity. They also found that adults with ADHD symptoms were less physically active. Similar results were found by Lassenius, Akerlind, Wiklund-Gustin, Arman, and Soderlund (2013).

Nevertheless, given the many difficulties those with ADHD face, it is not surprising that adults with ADHD are less satisfied with their lives. A lack of knowledge about health, lifestyle habits and physical fitness in adults (Semeijn et al., 2013) with ADHD remains, and it is important to pay attention to these factors (Semeijn et al., 2013; Spencer et al., 2014). Because of the chronic nature of ADHD, it is important to increase the understanding of vulnerability in light of health-related factors. We hypothesized that the studied ADHD sample had worse health outcomes and needed more comprehensive lifestyle support. There is an ongoing need for research regarding how nurses can support adults with ADHD in health and lifestyle habits. Therefore, the results from the present study will be used to develop the content of a forthcoming nurse-led lifestyle intervention. The objective of this study was to gain more knowledge about a population of persons with ADHD and their health situation. Is there a difference between the recruited ADHD sample and a random sample of the Swedish general population according to health, lifestyle habits, and physical fitness?

Method

Recruitment and participation

The participants in the ADHD population and in LIV population were recruited from four middle-sized counties with approximately 130,000–250,000 inhabitants. Adults with ADHD were recruited from two counties in northern Sweden in 2015; approximately 1000 potential adults with ADHD were living in the two counties. Participants were recruited through collaboration with the national association known as Attention (an interest organization for people with neuropsychiatric disabilities), from two open adult psychiatric clinics, and by announcements on the radio and in newspapers. In total, (n = 82) persons contacted the researcher by phone to receive more information about the study. In all (n = 48), 29 women and 19 men consented to participate. The inclusion criteria consisted of adults with ADHD and mental illness. Participants confirmed their own diagnoses of ADHD. In addition, researchers administered the ADHD Self–Report Scale (ARS) to confirm the ADHD diagnosis (Ustun et al., 2017). The participants also self-reported other mental disorders or mental illness; e.g. depression, anxiety, or autism. Exclusion criteria included acute mental illness and/or active self-reported substance/alcohol abuse, the inability to speak and read the Swedish language, or mental retardation.

Adults with ADHD were matched with and compared to a sample of adults from the LIV (Lifestyle-Performance-Health) project. Further details regarding each separate LIV study were published in (Ekblom, Engstrom, & Ekblom, 2007; Olsson, Ekblom, Andersson, Borjesson, & Kallings, 2016). The LIV project consists of a random sample from the Swedish general population recruited in 2013.

Samples were randomly selected from the Swedish population and address registry from selected counties in 2013–2015 (n = 3750). Each individual was contacted by mail with relevant study information and a form for written consent. The data were collected during 2013–2015. The inclusion criteria were having answered the questionnaire item regarding perceived physical health and participated in at least one of the other assessments. Exclusion criteria were confirmed invalid contact information, having moved outside Sweden or the respective county, or the inability to speak and read the Swedish language. Before the fitness tests, each participant was assessed by a physician for medical contraindications, such as previous dissuasion, chest pain, or injuries, each of which resulted in exclusion from the study. The samples then decreased to (n = 3357) total invited participants, woman (58,3%) and men (41,7%). Of the total invited participants, (n = 2413) did not respond in any way (71.9%). Two-hundred and ninety-two participants were lost because of explicitly declined participation or because they were unsorted (question mark, missing data). Six-hundred and fifty-two participants met the inclusion criteria in LIV 2013–2015 (19.4 %) (Olsson et al., 2018). The ADHD sample (n = 48) was then matched with the LIV sample from 2013 to 2015. The matching variables were conducted from equivalent counties (geographical area), sex, and age (±2 years). In total, 42 individuals from the 652 (22 women and 20 men) were identified and comprised the sample without ADHD.

Data collection and procedures

Comparisons were drawn between the ADHD and the Swedish general population group using the same questionnaires and physical fitness tests as described in the LIV project (Ekblom et al., 2007; Ekblom-Bak, Engström, Ekblom, & Ekblom, 2011; Engström, Ekblom, Forsberg, von Koch, & Seger, 1993; Olsson et al., 2018). All data for the ADHD group were collected in 2015. All data collection, (i.e. questionnaires and physical fitness tests) took place at a university test station during a single visit of about 1–1.5 hours. To assure the tests were conducted on an equal basis, the researchers (educated district nurses and mental health nurses) underwent a one-day theoretical and practical training session before performing the tests.

All selected participants in LIV (Lifestyle-Performance-Health) group were contacted by mail. Tests were performed at primary health care service locations. To assure the tests were conducted on an equal basis, test personnel underwent a one-day theoretical and practical training session. The questionnaires were answered by the participants before arriving for the physical fitness measures at the test centres.

Questionnaire measures

The self-administered LIV questionnaire is a blend of questions designed by the group of researchers who worked with the LIV-studies; they are nationally and internationally established questions (Ekblom-Bak et al., 2011; Engström et al., 1993; Olsson, 2016; Olsson et al., 2018). These questions are used in the Swedish National Board of Health and Welfare. The Health on Equal Terms questionnaire has been reviewed for validity (Boström & Nyqvist, 2010).

Background data

Background data included age, sex, geographic area, education, living alone/cohabiting, employment status, and financial condition. Education was measured using the question "Which is the highest level of education you have completed?" Answers were categorized as either elementary school, high school, or university. Living alone/cohabiting were measured using the question "Do you live with somebody?" Answers were categorized as living alone or cohabited. Employment status was measured by asking "What do you mainly have in terms of employment?" Answers were categorized as working meaning 100% employment. Unemployed means studying 100% or less, retired 100%, working less than 100%, or long term sick leave 100%. Cash margin was measured using the question "Should you suddenly find yourself in an unforeseen situation in which you had to get hold of 15,000 Swedish crowns in a week, could you manage this?" Answers were categorized as yes or no. These questions are used in the Swedish National Institute of Public Health annual Swedish Living Survey (SULF) (Boström & Nyqvist, 2010).

Health

The health domain included eight variables. General health was measured using the question "How do you rate your general state of health?" Answers were categorized as "good" (very good or good), "in-between" (quite good), or "bad" (bad or very bad). Physical health was measured using the question "How would you rate your physical health?" Answers were categorized as "good" (good or acceptable) or "bad" (not so good or bad). Mental health was measured using the question "How would you rate your mental health?" Answers were categorized as "bad" (very bad, bad, or not especially good) or "good" (acceptable, good, or very good). Life satisfaction was measured using the question "If you look at your overall life situation, how satisfied are you with

it?" Answers were categorized as "satisfied" (very satisfied, satisfied, or relatively satisfied) or "dissatisfied" (dissatisfied). Long-term illness was measured using the question "Do you suffer from any long-term illness?" Answers were categorized as "no" or "yes". Sleep problems were measured using the question "Do you have any kind of sleep problem?" Answers were categorized as "problem" or "no problem". General feelings about being (1) tired, (2) crummy, (3) lonely, (4) depressed, and (5) restless/anxious were respectively measured using the question "How have you generally felt during the last month?" Answers were categorized as "never", "almost never", "now and then", "often every week", "very often", or "always". For these questions, each response was rated from 1 to 5, and the sum for each answer yielded an index value of 5 to 25. Using this, a fatigue index was constructed (Cronbach alfa 0,89). Pain and discomfort was measured using the question "Which statement best describes your health condition today?" Answers were categorized as "I have no problems with pain or discomfort" or "I do have problems with pain and discomfort".

Lifestyle habits

Lifestyle habits were measured using six variables. Sedentary behaviour was measured using the question "How much of your awake time do you spend sedentary?" Answers were categorized as "almost always" or "almost no time". Exercising weekly was measured using the question "During a regular week, how much time do you spend exercising on a level that makes you short winded, for example running, fitness class, or ball games?" Answers were categorized as "0–30 min", "30–120 min" or "more than 120 min". Weekly physical activity was measured using the question "During a regular week, how much time are you physically active in ways that are not exercise, for example walks, bicycling or gardening? Add all activities lasting at least 10 min." Answers were categorized as "0–30 min", "30–120 min", or "more than 120 min".

Daily smoking was measured using the question "Do you smoke?" Answers were categorized into "daily smoking" or "no smoking". Daily use of snuff/chewing tobacco was measured using the question "Do you use snuff?" Answers were categorized as "yes" or "no". Alcohol use was measured using the question "How often do you drink: for woman 4 standard glasses and for men 5 standard glasses or more, at the same occasion?" Answers were categorized as "no" (never drink alcohol), "less frequently than monthly", or "yes" (drink alcohol every month, every week, daily or almost daily).

Information about diet was measured using two questions about fruit and vegetables: "How often do you eat fruit and how often do you eat vegetables?" For the former, answers were categorized as "no" (eat fruit rarely or a few times a week) or "yes" (eat fruit daily). For the latter, answers were categorized as "no" (eat vegetables few times a week) or "yes" (eat vegetables daily or more than once a day).

Physical fitness

Physical fitness was measured using six variables. Body mass index, defined as a person's weight in kilograms divided by the square of the person's height in meters (kg/m2), was measured in accordance with the recommendations of the (World Health Organization, 2017). Waist circumference was measured, with a circumference of ≥102 cm for men and ≥88 cm for woman considered to represent obesity grade 1 and associated with increased health risks (National Board of Health and Welfare, 2009).

Aerobic fitness

VO_2 max was assessed in accordance with the new Ekblom–Bak submaximal cycle ergometer test (Ekblom-Bak, Bjorkman, Hellenius, & Ekblom, 2014), which has been previously validated. First, the Borg rating perceived exertion (RPE) scale was introduced to the participants (Borg, 1970). The participants then cycled on a calibrated mechanically-braked cycle ergometer (model 828E; Monark, Varberg, Sweden). The test was based on the pulse change between two work rates. In the first, each participant cycled for 4 min with a standard load. In the second, the participant cycled for 4 min with a greater, individually-adjusted load. The tramp frequency was 60 rpm, and the average pulse was measured during the last minute of cycling with each load. Thereafter, the strain was immediately raised to a higher pre-set load so the participant would achieve a steady state pulse of 120 strokes/min (>110 beats per minute for persons over 50 years), indicating a general perceived physical exertion rate of ≈14 according to Borg's RPE scale. The average pulse during the last minute of cycling with the higher load was recorded. The maximum VO_2 was calculated using gender-specific equations based on the difference in pulse rate between the two loads, a factor corresponding to the higher load, the pulse at the lower load, and participant age (Ekblom-Bak et al., 2014).

Vertical jump was measured according to Markovic, Dizdar, Jukic, and Cardinale (2004). Participants jumped three times, and the greatest value was reported. Jumps were assessed using a measuring tape attached to a waistband and mounted under a plastic strip taped to the floor. Jump height in centimetres was determined by

reading the position on the measuring tape by the edge of the plastic strip.

During the sit-ups test, the participants were instructed to perform in accordance with Ekblom-Bak et al. (2011) and Engström et al. (1993). Participants were asked to perform three sets of five sit-ups of increasing effort at a voluntary speed from a completely horizontal position, with knees at a 90 angle and feet fixed to the floor. Arm positions varied as follows: during the first set, hands were to be placed on the upper sides of the thighs. To pass the test, fingers had to touch the patella when the abdomen was raised. During the second set, arms were to be crossed over the chest with fingers touching the clavicula, elbows pointing forward. To pass the test, elbows had to touch the thighs. During the third set, hands were to be held on the neck with elbows directed forward. To pass the test, elbows had to touch the thighs. Thus, the maximum number of sit-ups was 15.

The balance test was administered in accordance with Ekblom-Bak et al. (2011), Engström et al. (1993), Nantel et al. (2009), and Newton (1997), where the participant was to balance on one foot. The test was estimated using a unipedal quiet stance on a 3 cm Å ~ 5 cm Å ~ 50 cm bar for 60 seconds, and the number of times the participant lost balance and needed to step from the bar was measured (one was the minimum). The balance test has shown to be a reliable estimate of leg muscular and balance (Suni et al., 1996).

Statistical analysis

In order to assess the independent association between adult ADHD and health outcomes, lifestyle habits, and physical fitness, a comparison to a reference population was conducted. The first step of the analysis was to explore health, lifestyle habits, and physical fitness among ADHD adults and the reference population. This first step describes the groups and identifies potential confounders of the relationship between health outcomes, life style habits, and physical fitness. The multivariate analyses in the second step were conducted to include the potential confounders in the analyses if there was theoretical or empirical support for its potential as a factor relating to adult ADHD.

Amounts following percent and means with standard deviations (SD) were used to describe and explore the differences between groups. Differences between groups were furthermore investigated using independent t-tests for continuous variables and chi-square tests for categorical variables. Then, to control for potential confounding variables, binary logistic regression analyses were performed. Statistical significance was recognized when $p \leq 0.05$. Statistical calculations were performed using SPSS for Windows version 23.

Ethics

Written informed consent was obtained from each participant in the ADHD sample in accordance with the requirements of the Helsinki Declaration (World Medical Association, 2013). The Ethical Review Board in Umeå (No 2015/51-31) approved the study. The Regional Ethical Review Board in Stockholm (2012/1338-31) approved the LIV 2013 study.

Results

Descriptive background statistics covering age, sex, geographic area, education level, living alone/cohabiting, employment status, and sick leave for the ADHD and LIV groups are summarized in Table 1. The final sample was composed of 90 subjects (48 in the ADHD group and 42 in the control group). Because the groups were matched for age, sex, and geographic areas, these variables did not differ. Living alone/cohabiting was found to be similar as well. In

Table 1. Descriptive demographic data for the ADHD and LIV samples. Presented as n and % (n = 90).

	ADHD group n = 48	LIV group n = 42	Sig
Age, mean (SD)	36 (11)	38 (10)	0,383
Sex: f/m n (%)	29 (60)/19 (40)	22 (52)/20 (48)	0,588
Geographic area: Urban/Rural n (%)	31 (65)/17 (35)	26 (62)/12 (29)	0,709
Education: Elementary/High school/University n (%)	15/24/9 (31)/(50)/(19)	3/18/21 (7)/(43)/(50)	0,001
Living conditions: Alone/Cohabiting n (%)	21 (44)/27 (56)	11 (26)/28 (67)	0,135
Employment status: Unemployed/Employment/Sick leave n (%)	3/32/12 (6)/(67)/(25)	3/34/1 (7)/(80)/(2)	0,014
Cash marginal (15 000 SEK in a week) n (%)	27 (56)	33 (79)	0,008

Note: Internal losses. The ADHD group is 1 missing the value for employment status. The LIV group is missing 4 values for geographic area and living conditions, and missing 4 values for employment status.

contrast, differences in sick leave (p = 0,014), education (p = 0,001), and financial situation (p = 0,008) were found, compared to the LIV participants.

Summarizing the results in Table 2 shows that those with ADHD rate a higher proportion of bad general health, physical health, and mental health than those without ADHD (p < 0.000; p < 0.000; and p < 0.000). The former also report long-term illnesses (p = 0,001), sleep problems (p < 0.000), fatigue (p < 0.000), and poorer life satisfaction (p = 0,002). There were no statistical differences in perceived pain.

Table 3 describes the differences or similarities between the ADHD and LIV samples concerning lifestyle habits. The results show that those with ADHD demonstrate a higher proportion of sedentary behaviours (p = 0.042), are less physically active (p = 0.000: p = 0,014), marginally significant in eating less fruits and vegetables (p = 0.043 and p = 0,043), and use more tobacco compared to those without ADHD (p < 0.000: p < 0.25). No significant differences were found in alcohol use.

Summarizing the results in Table 4 shows that the ADHD sample demonstrates a significantly higher BMI (P = 0,001) and waist circumference (0,026). A higher proportion of maximum oxygen uptake (VO_2 max) was seen in the LIV samples (p = 0,004). Finally, the LIV sample also had a stronger vertical jump (P = 0,013) and more sit-ups (P = 0,002). The ADHD sample was better in the balance test, but these differences were not significant.

In Table 5, the detected differences shown in Tables 2–4 are controlled for potential biases resulting from differences between the groups in education, employment status, and cash marginal. The results of the logistic regression analyses for various health measures, lifestyle habits, and physical fitness

Table 2. A comparison of health measures in the ADHD and LIV samples. Presented as n and %.

	ADHD n=48	Liv n=42	Sig
General health:			
Bad/In between/Good n (%)	17(35)/24 (50)/1(2)	2(5)/8(19)/28 (65)	0,000
Physical health:			
Bad/Good n (%)	28(58)/20(42)	7(17)/32(76)	0,000
Mental health:			
Bad/Good n (%)	30(62)/18(38)	4(10)/35(83)	0,000
Life satisfaction:			
yes/n (%)	30 (62)	38 (90)	0,002
Long-term illness: (no long-term illness ref)	23 (49)	5 (14)	0,001
Sleep problems:			
Problem/No problem n (%)	29(60)/19(40)	6(14)/33(79)	0,000
Fatigue *(5–25): mean (sd)*	13 (4)	8 (3)	0,000
Pain			
Problem/No problem n (%)	31(65)/15(31)	19(45)/20(48)	0,081

Note: Internal losses. The ADHD group is missing 6 values for general health and 2 values for pain. The LIV group is missing 4 values for general health, 3 values for Physical health, 3 values for mental health, 3 values for sleeping problems, and 3 values for pain.

Table 3. A comparison of lifestyle habits measured in the ADHD and LIV samples, n and %.

	ADHD n=48	Liv n=42	Sig
Sedentary behaviour *n (%)*	7 (15)	1 (2)	0,042
Exercise weekly *n (%)*			
Less than 30 min	33 (69)	8 (19)	
30 min-120 min	9 (19)	17 (41)	
More than 120 min	4 (8)	14 (33)	0,000
Physically active weekly *n (%)*			
Less than 30 min	12 (25)	2 (5)	
30 min-120 min	17 (38)	10 (24)	
More than 120 min	16 (33)	27 (64)	0,014
Smoking daily *n (%)*	21 (44)	2 (5)	0,000
Snuff daily *n (%)*	21 (44)	9 (21)	0,025
Fruit daily *n (%)*	11 (23)	18 (43)	0,043
Vegetables daily *n (%)*	14 (29)	21 (50)	0,043
Alcohol *n (%)*	8 (17)	8 (20)	0,768

Note: Internal losses. The ADHD group is missing 1 value for sedentary behaviour, 2 values for exercise weekly, 3 values for physically active weekly, 2 values for fruit, and 5 values for vegetables. The LIV group is missing 3 values for sedentary behaviour, 3 values for exercise weekly, 3 values for physically active weekly, 3 values for smoking, 3 values for snuff, 5 values for fruit, 4 values for vegetables, and 4 values for alcohol.

Table 4. A comparison of physical fitness measures in the ADHD sample and the LIV sample, mean and standard deviation (SD).

	ADHD n=48	Liv n=42	Sig
BMI			
Mean (sd)	29 (7)	25 (4)	0,001
Waist circumference (cm)			
Mean (SD)	92,7 (18,1)	84,9 (11,1)	0,026
Estimated VO_2 max (mL/kg min)			
Mean (SD)	37,4 (9,67)	44,3 (9,08)	0,004
60 s balance			
Mean (SD)	5,8 (8,7)	4,4 (5,2)	0,38
Vertical jump (cm)			
Mean (SD)	35,5 (10,2)	45,8 (14,0)	0,013
Sit-ups			
Mean (SD)	12 (4,1)	14 (1,9)	0,002

Note: Internal losses. The LIV group's BMI and waist circumference had 15 missing values. 17 values for aerobic fitness, 10 values for balance and leg strength, and 10 values for sit-ups. The ADHD group was missing 2 values for balance.

Table 5. Adjusted odds ratios (ORs) and confidence intervals for various health measures, lifestyle habits, and physical fitness adjusted for education, employment status, cash marginal, and sex when comparing the ADHD group to the LIV group.

	Adjusted model
Bad general health *(good GH ref)*	13 (3,4–50)
Bad physical health *(good PH ref)*	2,8 (0,8–9,8)
Bad mental health *(good MH ref)*	5,1 (1,2–21)
Life satisfaction *(satisfied ref)*	5,5 (1,6–19)
Sleep problems *(no problems ref)*	8,3 (2,3–31)
Long-term illness *(no long-term illness ref)*	10 (2,3–45)
Fatigue *(5–25)*	1,5 (1,2–1,8)
Aerobic fitness *(VO2max/ml/kg)*	0,9 (0,8–1,0)
Sit ups	0,6 (0,4–0,9)
Leg strength	0,9 (0,8–1,0)
BMI	1,1 (0,9–1,3)
Waist circumference (cm) *(below 0,85/1,0 ref)*	1,1 (0,2–6,6)
Sedentary behaviour	1,4 (0,1–20)
Low weekly exercise *(more than 120 min/week ref)*	0,8 (0,2–3,4)
Low weekly psychically active *(more than 120 min/week ref)*	3,8 (1,2–13)
Smoking	16 (1,6–169)

Note: na = not available to measure.

adjusted for education, employment status, financial situation, and sex. When comparing the ADHD group to the LIV group, the differences between the groups remain in the majority, but not all, of the variables. For example, the risk for reporting bad general health is 13 times greater (OR 13; CI 3,4–50) in sleep problems (OR 8,3; CI 2,3–31), long-term illnesses (OR 10; CI 2,3–4,5), and smoking (OR 16; CI 1,6–169) in the ADHD group compared to the LIV group. For most of the variables the confidence interval is very large mostly due to sample size.

Discussion

The adults with ADHD in this study reported inferior values in health and lifestyle habits compared to the general population group. Adults with ADHD were less satisfied with life and have worse general health, mental health, and quality of sleep and are more often fatigued. ADHD participants were also more often ill long-term compared to the general population. These results stand unchanged even when adjusted for education, employment status, cash marginal, and sex. These findings support the aim and agree with previous research (Bernardi et al., 2012; Rogers, Dittner, Rimes, & Chalder, 2017; Semeijn et al., 2013; Spencer et al., 2014; Stickley et al., 2017).

The descriptive background statistics in Table 1 are consistent with previous research regarding sick leave, education, and financial situations (Barkley, Fischer, Smallish, & Fletcher, 2006; Beauchaine, Ben-David, & Sela, 2017; Biederman & Faraone, 2006; Kessler et al., 2005). Health inequalities are related to socioeconomic factors (Marmot, 2017) and a lower level of education increases development of cardiovascular disease and cancer (Swedish National Institute of Public Health, 2018). The question in this study regarding cash margins was calculated by Statistics Sweden and should correspond to a regular worker's salary and correlate with socioeconomic group identity and general state of health. In Table 2 the LIV samples predict positive self-rated health compared to the ADHD samples; positive self-rated health has been shown to be associated with socioeconomic factors (Reile & Leinsalu, 2013). This indicates that adults with ADHD in this study have a socioeconomic disadvantage and risk unequal health.

Many of the explored self-reported health questions are consistent with previous research regarding the negative health outcomes of adults with ADHD, such as poorer general health, and poorer lifestyles such as less physical activity, diet and tobacco use (Nigg, 2013). For example, according to Table 2 bad general health was worse in the ADHD group, and a higher proportion in the ADHD group were worse in all self-reported health questions. In Table 5 this result stands unchanged even when adjusted for education, employment status, cash marginal, and sex when comparing the ADHD group to the LIV group. Self-reported health is a complex concept and may be influenced by numerous factors. However, self-reported health has been found to be a strong predictor of future health and mortality (Ganna & Ingelsson, 2015). In a large meta-analysis of DeSalvo, Bloser, Reynolds, He, and Muntner (2006) found that the association between self-rated health and mortality remained after adjustments for depression, functional status, cognitive function, comorbidity, and socioeconomic status. Positive self-reported general health is no guarantee of good physical health, but poor self-reported general health certainly warrants further attention (Jylhä, 2009). Even if poor mental health is considered the primary reason for experiencing a poorer state of general health (Bernardi et al., 2012), this is reportedly a cause of several other health problems in ADHD adults that could contribute to lower perceived health. In a population study by John et al. (2005), psychiatric disorders were found to contribute to lower general health. A longitudinal follow-up study of adolescents with ADHD showed that impaired physical health and impaired mental health were associated with stress, which also contributes to lower health (Brook, Brook, Zhang, Seltzer, & Finch, 2013). A recent study in the US by Landes and London (2018) found that adult ADHD was associated with higher odds of poor health even controlling for demographic characteristics, psychiatric comorbidities, health behaviours, and adult social and economic statuses.

In Table 2, adults with ADHD in our study reported sleeping problems and fatigue; these results stand unchanged in Table 5. We did not take into account the information if the individuals taking ADHD drugs or other psychiatric drugs in relation to sleep. This may be seen as a confound when looking at sleep problems, especially since most drugs used for ADHD are stimulants. It is important to pay attention to sleeping problems because it is a well-known risk for health problems in the general population (Clark et al., 2016), theoretically increasing the risk for the ADHD group compared to the normal population.

Table 3 compares lifestyle habits and shows that the ADHD group exercised less, had more sedentary behaviour, smoked more, and used more snuff and chewing tobacco. These findings are supported by previous research (Jeoung, 2014; Lassenius et al., 2013; Suchert et al., 2017).

Type of mental illness or disorders among the ADHD individuals was unknown. All ADHD participants received health care in psychiatric open care or in primary health care, e.g. medication follow up, check of blood pressure, or support from occupational therapist according to cognitive impairments.

A somewhat surprising finding was that the ADHD group did not use more alcohol than the comparison group. This could perhaps be explained by the fact that all participants were on health care support, which could have decreased the risk of using

alcohol as a self-medication. Self–medication is a well-known phenomenon among persons with ADHD (Baker, Prevatt, & Proctor, 2012; Odell et al., 2017) as a way to cope with their symptoms. Or, it may be that the ADHD group in this study was more motivated to change their health and have a healthier lifestyle generally.

ADHD adults used more nicotine compared to participants in the LIV group, which agrees with the findings by van Emmerik-van Oortmerssen et al. (2012). Smoking is a lifestyle habit that is well recognized to co-occur with ADHD (Pagano, Delos-Reyes, Wasilow, Svala, & Kurtz, 2016). One explanation could be that nicotine can temporarily reduce the severity of ADHD symptoms, leading people to attempt to self-medicate (Potter, Bucci, & Newhouse, 2012). One of the leading causes of death due to cardiovascular diseases is smoking, according to the (World Health Organization, 2017).

Perhaps this study´s most interesting contribution is that it shows that adults with ADHD, despite their bad health and bad lifestyle habits, are about as physically fit as the normal population. However, a study by Olsson et al. (2018) found that self-reported general health was related to physical fitness and produced changes in the most important covariates from VO max and chronic illness in 1990 to BMI and educational level in 2015 in a random Swedish population. In Table 4, BMI and waist circumference are higher in the ADHD group, as well as worse aerobic fitness, compared with the LIV group. In contrast, in Table 5 this difference did not remain and the ADHD group was in favour when adjusted for education, employment status, and cash marginal. This could be an effect of confounding and small groups.

The finding that the ADHD adults, despite their worse health status, did not suffer from more pain than the comparison group is somewhat surprising and can perhaps be explained by acceptable or good physical fitness and relative young ages.

For example, good balance reduces the risk of fall injuries. The sit-ups test demonstrates abdominal muscle strength, which reduces the risk of back pain. Still, it is important to notice that 69% of the ADHD group, compared to 19% of the LIV group, were physically active less than 30 minutes per day. Only 8% in the ADHD group, compared to 33% in the LIV group, exercised more than 120 minutes per week. Therefore, it is important to pay attention to exercise in adults with ADHD because of its beneficial effects on cognitive functions and mental and physical health (Carek, Laibstain, & Carek, 2011).

ADHD represents a great variety of symptoms. Some people with ADHD can, with the help of various kinds of treatments and support, feel good and function well and can even benefit from their special way of functioning. Others are at risk of developing serious problems, causing great suffering and leading to risk for sick leave. Nigg (2013) explained that ADHD should not be seen as an isolated risk factor, but rather as a part of a constellation of psychopathological and personality-related risk factors for poor health. These facts might explain parts of the worse health and lifestyle outcomes among the adults with ADHD in this study.

Methodological considerations

Differences in health outcomes between the investigated groups could be influenced by the fact that few questions were used to measure complex phenomena such as health and lifestyle habits. Some limitations of this study should be considered. Firstly, because the study had a cross-sectional design, no conclusions can be drawn about causality. Secondly, the ADHD group had lower socioeconomic status. Regarding the question on employment status, the categorizations of answers is rather rough (i.e. employed, unemployed and sick-leave). With our small sample, we saw this as the best alternative. Hopefully our categorization will not influence the comparison between the two groups in any direction. Further: In the regression analysis (Table 5) the results are adjusted for employment status and other variables. Thirdly, ADHD participants accepted an invitation to participate in a nurse-led lifestyle program with an emphasis on health, lifestyle habits, and physical fitness, which could have led to selection bias. Fourthly, the LIV sample might also cause selection bias because only 19 percent of the total sample participated in the project. Fifth, the norm sample suffered from drop-outs, possibly caused by differing routines during the tests.

A strength of this study is the use of a matching procedure. Participants in the ADHD group and the general population group were well-matched in terms of home district, sex, and age. Another strength is the study's measuring instruments, which are recognized in the field and demonstrate both good reliability and validity.

Conclusions

This study may contribute to our understanding of vulnerability and marginalization in society in light of health-related factors. Adults with ADHD in this study showed worse health and lifestyle outcomes, but it is not possible to prove that the ADHD diagnosis is the cause. Other lifestyle factors that may be negative consequences of adult ADHD are lower levels of education, less success in working life, and minor financial margins influence. It is important that various actions at social, group, and individual levels are developed to improve health and lifestyles.

A nurse-led intervention for adults with ADHD should include actions to support general health and lifestyle habits with increased physical exercise. It is important to use longitudinal approaches in future studies seeking associations between health, lifestyle habits, and physical fitness among those with adult ADHD. Such approaches can result in more knowledge about the causality between studied variables. Also, it is important with qualitative studies to explore mechanisms beyond the status of health, lifestyle habits, and physical fitness among adults with ADHD.

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