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ORIGINAL ARTICLE

A nurse-led lifestyle intervention for adult persons with attention-deficit/hyperactivity disorder (ADHD) in Sweden

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ABSTRACT

Introduction: Attention-deficit/hyperactivity disorder (ADHD) is associated with lifestyle-related diseases. Therefore, a nurse-led lifestyle intervention including interpersonal relationships, health education and cognitive support was developed to facilitate healthier lifestyle habits.

Aim: The aim was to develop a lifestyle intervention and investigate its impact on mental and physical health

Method: The 52-week intervention included 35 adults with ADHD. In a pre- and post-test design, symptoms of ADHD were measured with the Adult ADHD Self-Report Scale, quality of life was measured with the Adult ADHD Quality of Life scale and mental health was measured with the Hospital Anxiety and Depression scale. Lifestyle habits and dimensions of health were measured by the Lifestyle-Performance-Health Questionnaire and physical fitness was measured by the VO2 Max Test and calculations of waist circumference and body mass index. Result: Post-tests for a group of 25 persons showed positive changes following the intervention regarding weekly physical activity, quality of life and general and mental health. Lifestyle habit support was found to be important. The impact of the intervention should be confirmed in a long-term study with a control group.

Conclusion: This intervention may be beneficial and may be implemented in a primary healthcare setting or in other open care units.

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Adult ADHD; clinical practice; interpersonal relationships; lifestyle intervention; nurse-led

Introduction

Adult attention-deficit/hyperactivity disorder (ADHD) is defined by core symptoms of inattention and/or hyperactivity and impulsive behaviour [1]. ADHD is a chronic lifelong neuropsychiatric condition persisting through adulthood and affecting risks of numerous long-term mental, social and physical health problems [2,3]. ADHD has an approximate 0.5%–3% prevalence; differences depend on investigated countries and applied diagnostic systems [4,5]. In Sweden, ADHD diagnoses and ADHD drug prescriptions have increased since 2006 [6,7].

Adults with ADHD often perceive high levels of stress that might increase the risks of mental illness and stress-related disorders [8]. ADHD is a complex condition, and more than 50% of persons with ADHD have at least one current comorbid psychiatric disorder (e.g. major depression, substance use disorders, social phobia) [9]. Psychiatric, physical and social comorbidities are associated with lifestyle habits [10,11]. For example, higher intake of tobacco, alcohol, and fast food [12,13] and lower fruit and vegetable consumption [14,15] are seen among persons with ADHD, and these lifestyle habits increase risks of metabolic syndrome and cardiovascular disease [16,17]. Depression is common and associated with sedentary behaviour [18], obesity [19,20] and metabolic syndrome [21]. Some studies also suggest that persons with ADHD have increased risks of developing type 2 diabetes [22,23].

Newly diagnosed ADHD with comorbidities results in poorer quality of life regarding psychological health [24]. Older adults with ADHD also show a serious quality of life impairments [25]. Both ADHD symptoms and deficient executive function affect health-related quality of life [26], and cognitive impairments in executive functions are common (e.g. difficulties in sustaining attention and increased distractibility) [27,28]. A consequence of functional impairments is lasting underperformance regarding actual talent resources, which might affect the working ability and social life [29].

ADHD adversely affects health-related quality of life in multiple domains, including life productivity, psychological health, life outlook, relationships [30], work productivity and regular daily activities [31]. Research also shows that some problematic ADHD consequences are experiences of loneliness and being misunderstood in social relationships [32]. ADHD may also result in reduced estimated life expectancy, which is the number of years of life remaining at a specific age [33].

In the general population, lifestyle interventions clearly represent a valid tool for reducing cardiovascular risk factors

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and should be implemented in risk groups [34]. Similar to findings in the general population [35], lifestyle interventions for persons with mental illness reduce cardiovascular risk factors, affect weight loss and improve diet [36]. Evidence suggests that physical exercise and higher physical fitness levels improve neurocognitive function in adults with ADHD and therefore may be potential protective factors against it [37]. Physical exercise interventions have also effectively reduced weight in overweight and obese adults [38] and reduced depression symptoms among adults with ADHD [39,40]. Physical exercise affects the dopamine system, which plays a major role in the biological explanation of ADHD [41], depression and obesity [42].

Previous research [35] and the 'Consensus of the European Network of Adult ADHD' [43,44] have noted that psychoeducation (health education) is important for adults with ADHD. Health education provides information about the ADHD diagnosis, strategies to address everyday problems and opportunities to share experiences with people in a similar situation [44,45]. A psychoeducation group programme for adults with ADHD (including lifestyle habit education) was shown to increase knowledge about ADHD and improve general life satisfaction [46]. Even so, there are few reports of holistic lifestyle interventions involving adult persons with ADHD, and support of lifestyle habit changes is often lacking. Persons with ADHD are also more likely to experience premature death and consume many healthcare resources [47,48]. Many persons with ADHD also receive unequal health care and insufficient lifestyle support compared to the general population [49,50].

Given the complex lifestyle habits in persons with ADHD, it may be inferred that lifestyle interventions based on a more holistic view of health are needed [11,44]. Group-based models seem to be the most commonly used design for lifestyle interventions for persons with mental illness [51]. A previous lifestyle intervention involving group education, interpersonal relationships and cognitive support may have mitigated health risks in persons with mental illness (anonymization). A combination of cognitive behavioural therapy and mindfulness has been effective in improving mental health in persons with ADHD [52]. Some evidence also showed that technology might be supportive of lifestyle habit change [53,54]. Cognitive support (e.g. weekly schedules) may reduce cognitive impairment impacts in daily life [55]. Therefore, we developed a group-based lifestyle intervention including interpersonal relationships, health education and cognitive support for individually adapted lifestyle habit change.

Aim

The aim was to develop a lifestyle intervention and investigate its impact on mental and physical health.

Design and methods

Lifestyle intervention was conducted and implemented, collecting data on mental and physical health among participants (adults with ADHD and comorbid mental illness) before, during and after the intervention.

Participants

The sample of adults with ADHD was recruited through collaboration with Attention and open adult psychiatric clinics and through radio and newspapers in Sweden in 2015. Participants were 18 years old or older and diagnosed with ADHD (self-reported) and comorbid mental illness (self-reported). The diagnosis was decided according to ICD10 [50]. Exclusion criteria included acute mental illness (e.g. psychosis), active substance/alcohol abuse (self-reported and/or apparent to the professional nurses), inability to speak and read the Swedish language and mental retardation. Eighty-two persons contacted the researcher by phone to receive more information about the study. Eligible informants received written information about the study's purpose and procedure and were advised to contact the researcher by phone if they wished to participate. In all, 48 people, 29 women and 19 men consented to participate.

Procedure and content of the intervention

First, the authors' (AB, YR) experiences from earlier lifestyle interventions for persons with mental illness, including the main components of interpersonal relationships, health education and individual cognitive support, were used as a design ([removed due to anonymization]).

Second, this nurse-led lifestyle intervention was adapted and developed in cooperation with Attention (a national association for people with neuropsychiatric disabilities) and an open adult psychiatric clinic. These stakeholders contributed with experience and knowledge regarding lifestyle habits, health and well-being in persons with ADHD. Third, individuals with ADHD were interviewed about their life situations (previously reported in [removed due to anonymization]). Fourth, in another study, a group of individuals with ADHD was assessed and compared to a population norm group matched for geographical location, sex and age (±2 years) regarding health, lifestyle and physical fitness (previously reported in [removed due to anonymization]). These results were a basis for the intervention design.

The nurse-led intervention occurred over 52 weeks in September 2015–October 2016. The nurses (group leaders, authors AB, YR) who developed and led the intervention specialized in psychiatric nursing, public health and diabetes care.

Participants were divided into four groups of 6–12 persons, based on their participation availability. The three main components included educational and practical components (Table 1). Practical components included technical support with WhatsApp and lifestyle habit support, health discussions and social support amongst group members and group leaders during the 52-week intervention.

1. The intervention was based on a patient-centred approach where *interpersonal relationships* between the

Table 1. Educational and practical components of the lifestyle intervention.

Educational components of the lifestyle intervention	
Meetings every other week for 20 weeks (sessions 1–10) and 8 follow-up meetings once a month (exercise and diet recommendations every session)	
Health education for 20 weeks	Health discussions for the whole 52-week intervention (exercise and diet recommendations every session)
The ADHD diagnosis (guest lecture)	Group discussion on the strengths and weaknesses of individuals with ADHD and the advantages of ADHD
Physical exercise recommendations (guest lecture)	Group discussion on how to be physically active
Diet recommendations	Group discussion on how to achieve a healthy diet; diet recommendations from the social board, for example, carbohydrates, protein, vitamins, fats, different diets
Physical health and how to handle and prevent symptoms of physical illness	Group discussion on how and what should be included in physical health and how to be healthy, as well as on comorbidity and treatments (asthma, stomach disorders, pain)
Mental health and how to handle and prevent symptoms of mental illness (guest lecture on burnout)	Group discussion on what should be included in mental health and how to stay healthy as well as on psychiatric comorbidity (depression, anxiety, autism, suicide) and how manage symptoms, for example, breathing techniques, relaxing exercises
Cognitive impairments and how to cope with them	Group discussion on cognitive impairments and how to manage them, for example, schedules, reminders
Lifestyle disorders and how to prevent them	Group discussion on sleep problems, stress, metabolic syndrome, type 2 diabetes, and risky living habits, such as use of alcohol/drugs, smoking, and sedentary behaviour
Working life and sick leave; financial support (guest lecture)	Group discussion on support and how adapt, tips, information and strategies
Social relationships	Group discussion on how to support social relationships, loneliness and structure and strategies in everyday life
Risky living habits, such as use of alcohol/drugs and smoking	Group discussion on how to handle risky living habits and about sexual life
Practical components of the lifestyle intervention	
Practical exercises	Activities
Different relaxation techniques tested during the group meetings	Training for each participant in relaxation and strategies for everyday life
Tactile massage	Tactile massage including hand and back massage
Physical exercises (walking, gymnastic exercises, gym, yoga, swimming)	Taking part in physical exercises with the purpose of doing activities together and alone and finding something useful for each individual; exercises were done with the group leaders
Individual lifestyle habit changes between the meetings	Working on individual goals for lifestyle habits changes supported by the group leaders.
Relationships	Eating dinner/lunch together
Information booklets	A summary of health education content
Activity diaries	Records of lifestyle habit changes as well as nursing prescriptions and follow up
Pedometers	Used to measure how many steps participants took in a day and as a motivational tool
Individual nursing prescriptions	Individual nursing prescriptions according to the lifestyle habit goals to achieve before the next meeting
Individual support for healthy lifestyle habit changes between meetings	Individual support from group leaders; cognitive support with schedules, phone calls, reminders, etc.; Motivational interviewing techniques for behaviour and strategies to develop individual capability for lifestyle habits changes.
Group education	Group support for lifestyle changes and follow up of individual nursing prescriptions

Follow-ups meetings (8) included the three main components interpersonal relationships, health education and cognitive support. The health education was adapted to the groups wishes and was focused on: vitamin D, sexual relationship, healthy cooking, working life, suicide, medications, mental health and living with ADHD in daily life.

group leader and group members were one of the three main components [56–59].

2. *Health education* was based on recent knowledge in health and lifestyle, including that on diet, physical activity, mental and physical [50,60–62] and scientific articles. Each session contained information on physical activity and diet in both health education (10 times) and at follow-up meetings (8 times), although the main topic of each meeting during the first 20 weeks varied. Four lessons with guest lecturers covered topics such as burnout, working life, physical activity and living with ADHD. The follow-up sessions included education on the group's individual needs and wishes.
3. A motivational technique was used to strengthen participants' ability to identify and change unhealthy lifestyle habits [63]. Individual *cognitive support* for healthy lifestyle habits was provided through activity diaries, pedometers and physical activity plans [64]. Cognitive support also included individual schedules, follow-up discussions and SMS reminders, phone calls and e-mail as well as personal training with group leaders (e.g. walking, training at sports centres). Participants received support for individual lifestyle habit changes both during and between the group education and follow-up sessions for 52 weeks.

Group leaders also supported participants with texts and pictures using a mobile phone application (WhatsApp). The total time the group leaders spent supporting each participant who wanted support varied from approximately one to three hours per week. Each group education session was divided into five sections: (1) relaxation for about 10 min; (2)

health education for about 40 min; (3) hands-on exercises (5-times out of 10) with walking, gym training, gym exercises, yoga, swimming and joint meals (both dinner and lunch); (4) health discussions with individual recipes and follow-up, approximately 40 min and (5) closing ceremony, approximately 5 min. Healthy refreshments consisting of fruit, vegetables, water, tea and coffee were provided during meetings.

Data collection

All data were collected in 2015. Questionnaires and physical fitness tests took place at a university test station during a single visit of about 1–1.5 h. The test persons (the group leaders) underwent a one-day theoretical and practical training session before performing the tests. The group leaders were present the entire time if participants needed support.

Measurements

All measurements were collected at the baseline pre-test (T1), after 10 group sessions (i.e. after 20 weeks) (T2) and after eight follow-up group sessions (i.e. after 52 weeks) (T3).

Demographic, socioeconomic and clinical data

Demographic information including age, sex, education and employment status were collected with a self-report questionnaire from the Lifestyle-Performance-Health (LIV) project [65–67]. Waist circumference and body mass index (BMI) were calculated as described by the World Health Organization [68].

Lifestyle habits

To evaluate lifestyle habits, the following questions from LIV were used: *sedentary habits* (How much of your awake time do you spend sedentary?) were categorized as almost always, ¾ of time, ½ of time, ¼ of time and almost no time; *weekly physical activity* (During a regular week, how much time are you physically active in ways that are not exercise, for example, walks, bicycling or gardening? Add together all activities lasting at least 10 min) was categorized as 0, <30, 30–60, 60–90, 90–120 or >120 min; *tobacco use* (Do you smoke? Do you use snuff?) answers were categorized as yes or no; and *eating habits* (How often do you eat fruit? and How often do you eat vegetables?) were categorized as 'no' if eating fruit/vegetables rarely or a few times a week or as 'yes' if eating fruit/vegetables daily [67,69,70].

Health and well-being

ADHD symptoms were estimated using the two subscales of the Adult ADHD Self-Report Scale (ASRS) – *inattention* (Cronbach's alpha, 0.86) and *hyperactivity-impulsivity* (Cronbach's alpha, 0.81) – with nine questions each. The response options were on a 0–4 Likert scale with the alternatives never, rarely, sometimes, often and very often. The ASRS total sum score ranged from 0 to 72 (Cronbach's alpha, 0.89); higher scores indicated more symptoms [71].

The Adult ADHD Quality of Life (AAQoL) scale, measuring health-related quality of life and function among adults with ADHD, comprised 29 items divided into four subscales*: life productivity* (Cronbach's alpha, 0.81), *psychological health* (Cronbach's alpha, 0.83), *life outlook* (Cronbach's alpha, 0.84) and *relationships* (Cronbach's alpha, 0.74). The items were scored from 1 (Not at all/Never) to 5 (Extremely/Very often) and were summarized for an overall score for general quality of life (Cronbach's alpha, 0.93) (total sum) and each subscale category. Raw scores were transformed to a 0–100 scale; higher scores indicated a better quality of life [49,72].

Various dimensions of health were assessed using questions from LIV: *general health* (How do you rate your general state of health?) was categorized as good (very good or good), in-between (quite good) or bad (bad or very bad); *physical health* (How would you rate your physical health?) was categorized as good (good or acceptable) or bad (not so good or bad); *general mental health* (How would you rate your mental health?) was categorized as bad (very bad, bad or not especially good) or good (acceptable, good or very good); and *sleep problems* (Do you have any kind of sleep problem?) were categorized as a problem or no problem [67,69,73].

Anxiety and *depressive symptoms* were measured by the Hospital Anxiety and Depression Scale (HADS). It consisted of 14 items divided into two subscales, depression (Cronbach's alpha, 0.71) and anxiety (Cronbach's alpha, 0.77), each question rated on a 4-point scale and scored between 0 and 3. The total scores for each subscale ranged from 0 to 21. Scores between 0 and 7 on a subscale indicated 'no anxiety/depressive symptoms', between 8 and 10 suggested 'possible anxiety/depressive symptoms', and between 11 and 21 represented 'probable for anxiety/depression' [74].

Fatigue was estimated by an index constructed from LIV, based on general feelings (How have you generally felt during the last months?) about being tired, crummy, lonely, depressed and/or restless/anxious. Answers were categorized as never/almost never, now and then, often/every week and very often/always. For these questions, each response was rated from 1 to 4, the sum of the answers yielding a fatigue index ranging between 5 and 20 (Cronbach's alpha, 0.89) [67,69,70].

Physical fitness was measured by maximal oxygen uptake (VO2 Max Test) during a submaximal cycle ergometer test [75]. The participants 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. A higher value indicated better physical fitness [67].

Ethics

Each participant gave written and verbal informed consent in accordance with the requirements of the Helsinki Declaration (World Medical Association). Before the physical fitness tests, each participant was assessed for medical contraindications for physical exertion. In cases of symptoms of high blood pressure and/or depression during the test in T1,

T2 and T3, the participants were assisted in making appointments at a primary healthcare centre. If the participants felt uncomfortable regarding health issues, they could contact the group leaders for support (e.g. contact with primary health care).

Data analysis

Descriptive statistics for the assigned conditions and outcomes were calculated using the respective samples. Means with standard deviations (continuous outcomes) and medians with ranges (categorical outcomes) are shown where appropriate, otherwise, prevalence (*n* [%]) is shown. Categorical outcomes were analysed using chi-square tests and continuous outcomes using independent *t*-tests. To detect differences within the intervention group, paired *t*-tests were performed (continuous outcomes). LIV, ASRS, HADS, AAQoL, VO2 max, and body composition measures were analysed with the non-parametric Friedman's signed-rank test (categorical outcomes). Only participants that fulfilled the tests in T1–T3 was included in the before and after tests. Generally, *p*-values ≤ 0.05 were considered statistically significant. Significance values in Tables 2–4 were corrected for multiple comparisons using Benjamin–Hochberg procedure of controlling the false discovery rate (false discovery rate = 0.25). Statistical calculations were performed using SPSS for Windows, version 24 (IBM, Armonk, NY, Corp). A post hoc power analysis was performed, resulting in a power of 76% using a sample of 35 subjects (alpha, 0.05) and an improvement in the self-rated general health of 16%. The improvement was chosen using a population-based Japanese study [76] with a mean self-rated health status of 3.6 (SD 1.2) in the ADHD group and 3.0 (SD 0.8) for the non-ADHD control group ($p < 0.05$).

Results

Thirty-five persons completed the intervention from T1 to T3, although 10 persons did not complete the tests at T3. The 35 participants attended more than 70% of the group meetings and completed all components included in the intervention, that is, T1–T3. Tests reported positive changes following the intervention for the whole group regarding weekly physical activity, quality of life (life productivity subscale), general health and mental health. Below, the results are presented for the whole group. At baseline (T1), 48 adults with ADHD consented to participate. All participants who entered the intervention ($n = 35$) completed the one-year intervention; some participants did not perform the tests in T3 and were considered missed tests (see Figure 1). At T3, twenty-five participants completed the measurements.

Demographic, socioeconomic and clinical data

The participants' backgrounds and demographic data are reported in Table 2.

Table 2. Demographics, socioeconomic and clinical data of participants from baseline (T1), after 20 weeks (T2) and post-intervention after 52 weeks (T3).

Demographic characteristic	T1 ($n = 48$)	T2 ($n = 35$)	T3 ($n = 25$)	*p*-Value
Age, Mean SD (years of age)	36 (11)	37 (11)	35 (11)	1.000
Sex (female/male, *n* [%])	29 (60)/19 (40)	21 (60)/14 (40)	14 (58)/10 (42)	0.881
Civil status (*n* [%])				
Cohabiting/married	22 (46)	14 (40)	11 (44)	
Single	26 (54)	21 (60)	14 (56)	
Socioeconomic characteristic				
Education (*n* [%])				0.881
University	13 (27)	12 (34)	7 (28)	
High school	28 (58)	19 (54)	14 (56)	
Elementary school	7 (15)	4 (12)	4 (16)	
Employment (*n* [%])				0.939
Work (100%)	11 (23)	9 (26)	5 (20)	
Work (75%)	6 (13)	4 (11)	4 (16)	
Work (50%)	5 (10)	3 (9)	4 (16)	
Sick leave (100%)	14 (29)	7 (20)	6 (24)	
Unemployed/studying	12 (25)	12 (34)	6 (24)	
Clinical characteristic				
Years with ADHD (*n* [%])			14 (56)	0.204
1–5 years	20 (42)	16 (46)	4 (16)	
6–10 years	13 (27)	6 (17)	0 (0)	
>10 years	3 (6)	3 (9)	7 (28)	
No answer	12 (25)	10 (29)		
Pharmacological treatment (*n* [%])				0.371
In treatment	41 (85)	25 (71)	18 (72)	
No treatment	7 (15)	10 (29)	7 (28)	
Body Mass Index (BMI) (*n* [%])				0.747
Normal weight (BMI 18.5–24.9)	15 (31)	11 (31)	10 (40)	
Pre-obesity (BMI 25.0–29.9)	15 (31)	9 (26)	4 (16)	
Obesity class I, II, III (BMI > 30)	18 (38)	15 (43)	11 (44)	
Waist circumference				0.070
>102 (men)/>88 (women)	20 (42)	16 (46)	9 (36)	
<102 (men)/<88 (women)	28 (58)	18 (51)	14 (56)	

Internal losses: waist circumference 2 in (T3).

The group was equally distributed respecting demographics, socioeconomics and clinical characteristics on all three occasions. There were no differences in demographic, socioeconomic or clinical characteristics between dropouts/missing tests in T1, T2 and T3 compared with completers. Most participants were educated to high school level. Most participants were on sick leave and could not work full-time. Participants had been diagnosed with ADHD on average 1.5 years before participating in the intervention. Most with ADHD had several years of ongoing contact with psychiatric service providers, and more than 70% had pharmacological treatment for mental illness or ADHD symptoms.

Table 3. Results of lifestyle habits measures from baseline (T1), after 20 weeks (T2) and post-intervention after 52 weeks (T3), $n = 25$.

Lifestyle-Performance-Health Questionnaire (LIV)	T1	T2	T3	*p*-Value
Sedentary habits (*n* [%])	$n = 24$	$n = 24$	$n = 25$	0.531
All time	4 (16)	2 (8)	2 (8)	
3/4 of time	6 (24)	10 (40)	10 (40)	
1/2 of time	10 (40)	9 (36)	10 (40)	
1/4 of time	3 (12)	2 (8)	2 (8)	
No time	1 (4)	1 (4)	1 (4)	
Weekly physical activity (*n* [%])	$n = 24$	$n = 24$	$n = 25$	
0 min	11 (44)	0 (0)	0 (0)	0.014[2]
<30 min	2 (8)	2 (8)	2 (8)	
30-60 min	4 (16)	4 (16)	4 (16)	
60-90 min	4 (16)	6 (24)	1 (4)	
90-120 min	1 (4)	2 (8)	3 (12)	
>120 min	2 (8)	10 (40)	15 (60)	
Tobacco use (*n* [%])	$n = 25$	$n = 25$	$n = 25$	
Smoking	8 (32)	7 (28)	8 (32)	0.368
No smoking	17 (68)	18 (72)	17 (68)	
Snuff	10 (40)	10 (40)	9 (36)	0.651
No snuff	15 (60)	15 (60)	16 (64)	
Eating habits (*n* [%])				
Fruit daily	6 (24)	9 (36)	9 (36)	0.091
No fruit daily	19 (76)	16 (64)	16 (64)	
Vegetables	5 (20)	7 (28)	8 (32)	0.500
No vegetables	15 (60)	14 (56)	13(52)	

Notes. $p \leq 0.05$, Placement of significance are presented as following: [1]difference between T1 and T2, [2]T1–T3, and [3]T2–T3.
Internal losses: ADHD participants missing value for sedentary behaviour 1 missing, weekly physical activity 1 missing, vegetables missing values 5; 4; 4.

Lifestyle habits

Results from the 25 participants regarding sedentary behaviour, physical activity, tobacco use and eating habits are given in Table 3.

Across the whole group, there were no significant improvements in *sedentary habits*. *Weekly physical activity* for participants improved significantly ($p = 0.019$). Eleven participants engaged in no physical activity at T1, but improvements were observed such that all participants were physically active at T2 and remained so at T3.

Regarding *tobacco use*, smoking or using snuff showed no improvement across the whole group; nor did *eating habits* significantly improve.

Health and well-being

Results regarding participants' ADHD symptoms, quality of life, general health, physical health, mental health, sleep

Table 4. Results of health and wellbeing measures from baseline (T1) to after 20 weeks (T2) and post-intervention after 52 weeks (T3).

	T1	T2	T3	*p*-Value
ASRS, Adult ADHD Self-Report Scale (median, range)				
Inattention	25.5 (20)	24.5 (32)	25 (32)	0.326
Hyperactivity-impulsivity	18 (14)	18(12)	17(15)	0.916
AAQoL, Self-reported quality of life scale (median, range)				
Quality of life, total points	44 (80)	45 (61)	46 (58)	0.568
Life productivity	41 (66)	41 (80)	51 (82)	0.001[2]
Psychological health	44 (71)	42 (75)	46 (75)	0.542
Life outlook	39 (61)	39 (57)	36 (54)	0.827
Relationships	58 (70)	60 (75)	42 (85)	0.046[3]
Lifestyle-Performance-Health Questionnaire				
General health (*n* [%])				0.025[1]
Good	3 (12)	7 (28)	7 (28)	
In-between	11 (44)	9 (36)	11 (44)	
Bad	11 (44)	8 (32)	5 (20)	
Physical health (*n* [%])				0.148
Good	11 (44)	10 (40)	15 (60)	
Bad	14 (56)	14 (56)	10 (40)	
Mental health (*n* [%])				0.368
Good general mental health	16 (60)	14 (56)	13 (52)	
Bad general mental health	9 (40)	10 (40)	12 (48)	
HADS, Hospital Anxiety and Depression Scale (median, Range)				
Anxiety	12 (18)	13 (15)	12(18)	0.985
Depressive symptoms	10 (14)	8 (18)	8 (14)	0.014[2]
Lifestyle-Performance-Health Questionnaire				
Sleep problems (*n* [%])				0.664
Sleep problems	7 (28)	10 (40)	10 (40)	
No sleep problems	17 (68)	14 (56)	14 (56)	
Fatigue (median, range)				0.220
Fatigue (index, 5–20)	14 (14)	12 (14)	12 (11)	
VO2 max, Aerobic fitness VO2 Max Test				0.740
Physical fitness (VO2max mL/kg min) (mean, sd)	37 (10)	39 (8)	39 (9)	

Notes. $p \leq 0.05$. Placement of significance are presented as following: [1]difference between T1 and T2, [2]T1–T3, and [3]T2–T3.
Internal losses: ADHD participants missing value for quality of life – 2 missing, general health – 2 missing, physical health – 1 missing, sleep problems – 1 missing, V02max – 1 missing, ARS – 2 missing, mental health – 1 missing, HADS – 3 missing.

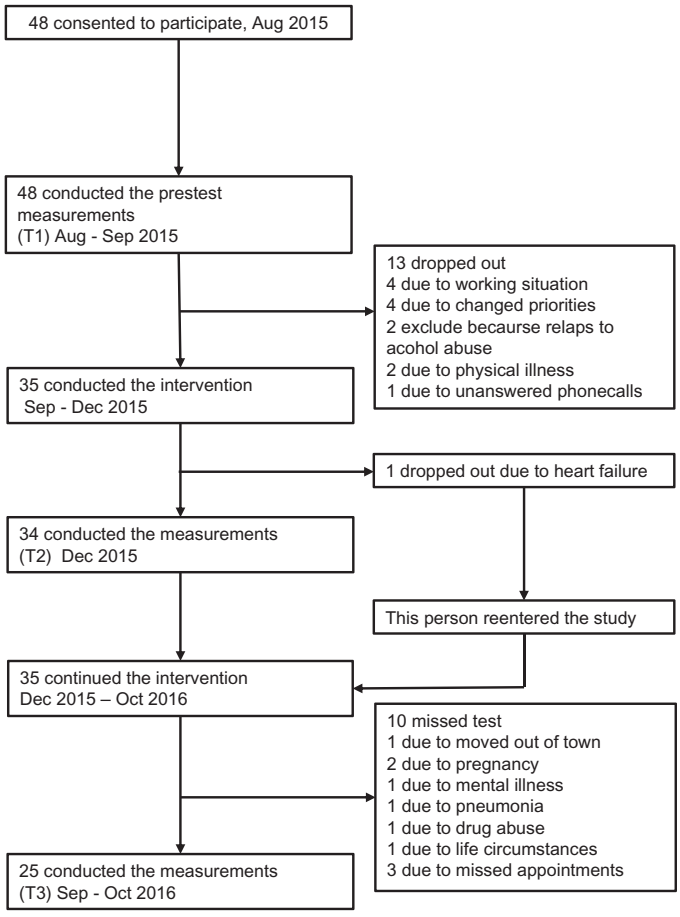

Figure 1. Flowchart of the lifestyle intervention.

problems, fatigue and physical fitness measures are given in Table 4.

The *inattention* symptom showed no significant improvement across the whole group ($p = 0.326$); nor did *hyperactivity* or *impulsivity* ($p = 0.916$).

The group demonstrated no significant improvements in the total *quality of life* score ($p = 0.568$). However, the *quality of life* subscale *life productivity* showed significant improvements for the whole group ($p = 0.001$), and the subscale *relationships* significantly decreased between T2 and T3.

General health for all participants significantly improved ($p = 0.025$) from T1 to T2 but was not maintained at T3. For self-rated *physical health* and *mental health*, there were no significant improvements, although there was a tendency of improvement for the former measure. Symptoms of *depression* decreased for all participants, a significant improvement ($p = 0.014$). Regarding *anxiety, sleep problems*, *fatigue* and *physical fitness*, we detected no significant improvements for the whole group.

Discussion

The study's aim was to develop a lifestyle intervention and investigate its impact on mental and physical health. Despite participants with ADHD experiencing limitations, for example, poor mental health and long trips, most chose to participate in the group education sessions. The study results implied a great interest in participating and remaining in the intervention, which strengthened the intervention's usability.

Lifestyle habit changes are difficult, and only 7% of the general population reach recommended physical activity guidelines [77]. Physical activity is the most important lifestyle habit change, affecting dopaminergic and noradrenergic systems, thereby improving ADHD-caused symptoms [78]. In the present intervention, both individual and group lifestyle habit support was included. Results indicated that this nurse-led lifestyle intervention may be helpful in increasing physical activity, which may lead to improved concentration, decreased stress and better health and well-being. This correlates with other studies showing the relationship between physical activity and ADHD [39,40,79]. In this intervention, the *weekly physical activity* increased, probably due to ongoing support for individual lifestyle habit changes; this support came from group leaders and group members as well as other supportive components, for example, phone calls, SMS, schedules, reminders, exercising together and WhatsApp.

Regarding health education, experiences with healthy and unhealthy living may help in developing coping strategies for physical and mental health and might positively influence self-efficacy and empowerment. Dahlqvist Jonsson and colleagues [80] suggested that a nurse-led education may increase health knowledge which might be essential in shared decision-making and promoting healthy lifestyle habits.

Only one in 10 Swedish adults follows the guidelines of eating five servings of fruit and vegetables per day [81]. During health discussions, several participants shared their own support tools (e.g. food planning and healthy recipes) and supported each other (e.g. posted pictures on WhatsApp).

The *quality of life* score was rated low at T1 in the present study, common for persons with ADHD and comorbidities [24]. ADHD may result in poor interpersonal skills, loneliness and few close friends these persons. Many participants in our study needed to discuss issues with others in the same situation but kept their diagnosis from co-workers and friends, lest they are stigmatized. In these groups, the participants found friends in the same situation. A study of adolescents with ADHD found that accepting help from others is also helpful for stress [82].

Life productivity (subscale of the quality of life measure) improved, which is important, since many participants self-reported cognitive impairments and mental health symptoms and were on sick leave or not working full-time. The *relationships* (subscale of the quality of life measure) improvements were not maintained after 52 weeks; this score decreasing from T2 to T3 may indicate that reducing group meetings to once per month (from T2 to T3) was not beneficial. A relationship with others provides support to maintain physical activity as well as emotional support [83]. In this intervention, there were supportive relationships, for example, a Facebook group. Participants also solved problematic situations for each other. The findings may also be supported by earlier research regarding person-centred psychoeducational

interventions, where expressing experiences, developing social relationships and meeting new friends as well as taking part in stimulating activities was found to be health-promoting [58]. The improvements in mental health symptoms could be explained by many possible factors, for example, increased physical activity, supportive interpersonal relationships and better-coping strategies.

There were no significant improvements in *physical fitness* (from T1 to T3), possibly because participants overestimated their physical activity levels; it could also be due to the small number of participants in our study. However, our experience was that for some participants, the fitness test may be a motivating tool for increased physical activity, which can increase health in the longer term and is particularly important among those with mental illness [18,77].

On the positive side, in the present study, the median change in waist circumference (not shown in tables) was −2 cm, and 15 participants showed a decrease of 1–9 cm. Importantly, five participants' BMI decreased from a baseline of normal weight (BMI 18.5–24.9), indicating that individual follow-up is vital for detecting unhealthy weight loss.

In summary, the results imply positive lifestyle changes regarding some variables measuring weekly physical activity, quality of life, and general and mental health. Juel and colleagues [84] found similar results. The effects of our lifestyle intervention might also relate to combining individual and group activities within the intervention. That is, the intervention's holistic approach might be successful, but it is difficult to confirm which part was most effective.

To ensure validity and reliability and reduce risks of bias, all participants received the same instructions from the group leaders for completing the scales and the same assistance and explanations of the scales' content. The same person was present when the participants' scales and measurements were taken. The activity diary and pedometers were used only at the beginning because many of the participants lost them. The choice of tests and scales worked relatively well for the study aims. A negative aspect may be that the participants took a long time to complete the question in LIV, as expected for persons with ADHD (∼50 min), who are often bothered with cognitive disabilities. From that, one can assume that questionnaires should be formulated differently when working with this group. Regarding difficulties linked to the ADHD diagnosis, questions should be fewer, shorter, and more interestingly presented (e.g. visualised with images).

In summary, interventions with adults with ADHD require more extensive support and resources when following up than was possible in the present study.

Limitations and strengths

Our study is limited in scale, and the results should, therefore, be interpreted with caution and primarily be seen as explorative. This intervention consisted of several integrated parts; it is impossible to pinpoint the underlying cause of the detected improvements. Although each group session and individual support followed the same structure, it is impossible to gauge whether all participants received the same content, especially because relationships between group members might have varied. Another limitation was that the group leaders who performed the intervention also performed the tests.

Although the study had dropouts (10 persons), 35 persons completed the intervention but did not complete the tests in T3. However, the missed tests in T3 might be related to practical circumstances and mental and physical conditions. Another lifestyle intervention performed with a general population sample showed a similar dropout rate [85]. We offered the participants several times to fulfill the tests but the nature of ADHD may also make it difficult.

It might have been that the participants who did not participated in all the tests were in worse condition or not found that the intervention was helpful for them. We have found no differences between the participants that fulfilled T1–T3 and the participants that not fulfilled the tests according to demographics, socioeconomic and clinical data of participants (see Table 2). However, the relatively large dropouts in the study mean that the results must be interpreted with caution.

Strength in the study is the three measuring points, the use of mainly validated questionnaires, and the combination of self-rated data and objective measures of physical fitness.

Relevance for clinical practice

Brown et al. [86] found that adults with ADHD have significant disabilities affecting everyday life, despite treatment. Therefore, this lifestyle intervention should be further developed and evaluated with a longer follow-up period. However, it is important in further studies to discover which components in the intervention are specifically important for observed improvements. Nurses should be taught how to perform the intervention.

Group sessions should be given every other week and combined with continuous, ongoing, individually adapted lifestyle habit support between group sessions. Each participant should preferably have access to a person who actively supports and motivates healthy lifestyle habits regularly over time, for example, a healthcare professional or an intimate partner/peer. More focus could be placed on physical fitness-enhancing activities which probably increase self-rated health.

Comprehensive lifestyle support might be needed to make sustainable lifestyle changes in this group [8,78]. Healthcare providers must be aware of the high prevalence of somatic comorbidity and higher medical cost for persons with ADHD compared to those without [87]. This complex intervention includes important nursing strategies together might release health problems caused by ADHD. The intervention may be implemented in a primary healthcare setting as well as in other outpatient clinics for persons with ADHD. To further investigate which of components in the intervention that are of specific importance for observed improvements, a study for a longer period and an RCT study would be preferable.

Author contributions

AB: substantial contribution to the conception of design and interpretation of the data. AB, EW, SV, NO: Interpretation and analysis of data. All authors gave final approval of the manuscript for publication.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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