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PhD thesis, 2009  
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The effectiveness of  
a multidisciplinary intervention program on  
low back pain and sickness absence

Cluster randomized controlled study of Stress management,  
Physical training and Patient transfer techniques  
in Health and Social Care Education

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## **1. Preface**

The project “Sunde rygge for social og sundhedselever” [Healthy backs for student nursing assistants] was on the drawing board in the period 2003-2004. DMSc Niels E. Ebbenhøj from the Department of Occupational and Environmental Medicine, Bispebjerg University Hospital, The Capital Region of Denmark, designed the study and was responsible for coordinating the project with the National Research Centre for the Working Environment and the Health and Social Care Education Program. Data were collected in the period April 2004 to February 2006.

The present Ph.D. thesis is based on the data from this project. The Ph.D. project began in October 2005, when I was invited to process the data, make the statistical analyses and report the findings of the investigation. The project was housed at the Department of Occupational and Environmental Medicine. Hence I have only participated in data collection from October 2005 till February 2006.

My thanks are due to associate professor Kirsten Schultz-Larsen Ph.D. from the Department of Social Medicine, the Institute of Public Health, University of Copenhagen, who was most constructive in supervising this thesis, MD Ole S. Mortensen Ph.D., who was equally helpful along the way as my supervisor, DMSc Niels E. Ebbenhøj, who was most helpful as the day-to-day project leader and supervisor, DMSc Poul Suadicani, who was equally helpful as my statistical supervisor and Professor emeritus, DMSc Finn Gyntelberg, who was my supervisor in the initial year of the project, all from the Department of Occupational and Environmental Medicine.

My special thanks are due to statistician Jacob Louis Marott from the Copenhagen City Heart Study for providing professional guidance in the selection of appropriate statistical methods and inspiring discussions; Professor Jacob B. Bjørner from the National Research Centre for the Working Environment for guidance and recommendations on methodology in SF-36 questions; Professor Finn Diderichsen from The Department of Social Medicine, who opened the doors to my stay in a different research environment and PhD student Christina Warrer Schnohr and my fellow PhD students at the Department of Social Medicine for offering great support. On a more personal note my special thanks are due to my family for having shown the utmost patience and support.

The project was funded by The Working Environment Research Fund (The Danish Employment Ministry).

## **2. List of papers**

This PhD thesis was based on the following papers:

1. Svensson AL, Strøyer J, Ebbenhøj NE, Mortensen OS: Factors predicting dropout in student nursing assistants. Occupational Medicine 2008; 58:527-533.

2. Svensson AL, Strøyer J, Ebbenhøj NE, Schultz-Larsen K, Marott JL, Mortensen OS, Suadicani P: Multidimensional intervention and sickness absence in assistant nursing students.

Occupational Medicine 2009; Oct.4 [Epub ahead of print]

3. Svensson AL, Ebbenhøj NE, Mortensen OS, Suadicani P, Schultz-Larsen K.

Intervention against low back pain among assistant nursing students

-Who benefits?

Manuscript submitted to Applied Ergonomics

## **3. Abbreviations**

NA	Nursing Assistants
HSCE	Health and social care education
LBP	Low back pain
ICC	Intraclass correlation coefficients
BMI	Body Mass Index
LTPA	Leisure time physical activity
GH	General Health
MH	Mental Health
SE	Self Efficacy

#### **4. Summary**

When handling patients, nursing assistant students (NA) and student nurses are frequently exposed to risk factors for self-reported low back pain (LBP), including sudden loads and twisting and bending of the spine. Furthermore LBP is a major cause of sickness absence. In addition to these basically physical demands, NA students must cope with the burden of emotional demands, as they are often in close contact with patients suffering from dementia illness, depression and terminal conditions. This mental strain is considered to put stress on the NA students.

The overall aim of the study was to evaluate the effect of a multidisciplinary intervention program for stress management, physical training and patient transfer techniques in health and social care education (HSCE) on low back pain (LBP) and sickness absence during 14 months (the duration of the education program). A secondary aim was to evaluate whether the intervention reduced the dropout rate from the HSCE.

A cluster randomised, controlled study was carried through. The participants were 790 NA students from 38 randomly selected classes at two schools of health and social care in the Region of Copenhagen, Denmark. When commencing the study and after completion of the study, the participants completed a comprehensive questionnaire and their physical fitness was assessed at the same time.

The main findings of this thesis were: 1) NA students with a history of LBP have an increased risk of dropout from health and social care education when an increasing number of risk factors are present: a previous history of exposure to heavy physical workloads, a low mental health score and not passing a back extension endurance test. When two or more risk factors were present it explained 39% of the dropout rate. There was no intervention effect on the dropout rate.

2) Sickness absence during the study period, was significantly lower in the intervention group. The mean (SD) number of days was 12 (20) versus 18 (34),  $p < 0.05$ . Furthermore, no significant deterioration was observed in the intervention group regarding general health perception (GH), Vitality (VT), and mental health (MH), whereas in the control group, scores for all these health measures were significantly lower at the time of follow-up. 3) The LBP prevalence from baseline to follow-up, increased at the same rate in the intervention and the control group. The subgroups who benefited most from the intervention were those with health awareness, good general health, energy and without LBP. In conclusion, the intervention program among NA students in HSCE promoted a significant reduction in sickness absence, but failed to prevent LBP. The intervention program did not prevent dropout from the HSCE.

## 5. Danish Summary

I forbindelse med pleje af patienter og borgere, er social- og sundhedselever hyppigt eksponerede for risikofaktorer for selvrapporterede lænderygmerter i form af pludselige belastninger, rotation og fleksion af rygsøjlen. Derudover er lænderygmerter en af de hyppigste årsager til sygefravær. Udover disse fysiske krav i arbejdet er plejen psykisk krævende, idet social- og sundhedseleverne skal håndtere høje følelsesmæssige krav, eftersom de ofte er i kontakt med patienter som har demenssygdomme, depression eller er døende. Denne psykiske belastning formodes at stresse social- og sundhedseleverne.

Formålet med studiet var at evaluere effekten af et multidisciplinært forebyggelsesprogram, som kombinerer stresshåndtering, fysisk træning og personforflytningsteknik blandt social- og sundheds elever, på sygefravær og lænderygmerter. Desuden blev det undersøgt, om interventionen ville få flere elever til at gennemføre uddannelsen.

Undersøgelsen var tilrettelagt som et cluster randomiseret kontrolleret studie. Deltagerne var 790 social- og sundhedselever fra 38 tilfældigt udvalgte klasser. Undersøgelsen fandt sted fra 2004-2006 på social- og sundhedsuddannelserne i det tidligere Københavns Amt og i Københavns Kommune. Eleverne udfyldte et omfattende spørgeskema, når de påbegyndte uddannelsen, og da de afsluttede uddannelsen. Desuden fik de testet deres fysiske fitness med fysiske tests.

Hovedfundene i denne afhandling var at 1) Social- og sundhedselever med en tidligere lænderygsmerte anamnese havde en øget risiko for at falde fra på social- og sundhedsuddannelserne, når et stigende antal risikofaktorer var tilstede: tidligere eksponering for tungt fysisk arbejde, manglende gennemførelse af en rygudholdenhedstest og en lav score for psykisk velbefindende. Når to eller flere af de nævnte risikofaktorer var til stede, forklarede modellen 39% af frafaldet.

2) Sygefraværet i løbet af studie perioden var signifikant lavere i interventionsgruppen, mean (SD) antal dage 12 (20) versus 18 (34),  $p < 0.05$ . Interventionsgruppen rapporterede ingen ændringer i deres baseline gennemsnit for generelt helbred (GH), vitalitet (VT) eller psykisk velbefindende (MH) ved follow-up, mens kontrolgruppen rapporterede et fald på disse skalaer. 3) Prævalensen af lænderygmerter steg fra baseline til follow-up til samme niveau i interventions- og kontrolgruppen. De delgrupper, der havde mest effekt af interventionen, var karakteriseret ved at gøre noget for at bevare deres helbred, have et godt selv vurderet helbred, energi samt ingen lænderygmerter.

Konklusionen er at interventionsprogrammet viste en reducerende effekt på sygefraværet. Interventionen havde imidlertid ingen forebyggende effekt på lænderygmerter eller frafaldet på social- og sundhedsuddannelserne.

## **6. Introduction**

The aims of this PhD thesis was to evaluate the effect of an intervention program on stress-management, physical training and patient transfer techniques among nurse assistant students in health and social care education (HBCE) aiming at reducing low back pain, sickness absence and dropout from HBCE.

### **Recruiting and retaining health care staff**

The demographic development in Denmark and the Western world will result in an increasing population of elderly people.

In addition, treatments have been transferred from hospitals to the primary care sector. The substantial future need for manpower in the social and health care services imposes high requirements for the recruitment and retention of qualified health care staff, if the aim is to maintain the current service levels for the elderly. It is therefore necessary to consider how to retain qualified health care personnel in future and, in addition, maintain their work capacity throughout their working life.

### **Work environment**

When they are working in the homecare service and at nursing homes, nursing assistants and nursing assistant (NA) students provide most of the practical care for their patients (bathing, dressing, transferring from bed to chair and feeding). In addition to these basically physical demands they must cope with the burden of emotional demands, as they are often in close and long-time contact with patients suffering from dementia, depression and terminal conditions (1). These emotional demands are considered to put stress on the NA students.

### **Student nursing assistants**

A study carried out in the social and health care education programs in Hillerød has shown that nursing assistant students, compared with other students of their age who take other education and training programs, are distinct in several points. They have a record of more days with back pain and more sickness absence and are more liable to seek treatment for their pain; they are less physically active in their leisure time and have lower scores in both physical tests and on general health measures (2). Thus, the study indicates that even before they join the social and health care

sector, nursing assistant students have the disease and psychosocial patterns of staff already employed in social and health care service.

The dropout rate among student nursing assistants in Danish health and social care education (HBSE) is high and has increased from 14% in 1993 to 24% in 2003 (3). A corresponding dropout rate, 15-20%, has been reported among student nurses in the UK (4). Danish reports have mainly focused on reasons for dropout related to the organization of the education itself and not on individual factors related to health, lifestyle and physical fitness (3). A significant part of the dropout in HBSE is during practical training periods, due to the so-called “practice shock” (5,6). The causes of dropout are numerous, but practical training supervisors have pointed out that personal skills in particular, such as self-confidence and the ability to cope with difficult situations, are not achieved to a sufficient degree by all students (5).

### **Low back pain**

Low back pain (LBP) is a significant health problem in the Western world with a lifetime-prevalence of 60-90% (7). A high prevalence of LBP has substantial consequences for the individual, e.g. pain and disability, and for society due to sickness absence and the high healthcare utilization, rising costs of care and perceived limits of treatment effectiveness (8).

Several risk factors for self-reported LBP have been identified. The most important are patient handling (9,7) including sudden trunk loading (10), psychosocial factors (11) and obesity (12).

Patient handling seems to be an independent risk factor for LBP (7, 9). When health care staff are handling patients they are often exposed to a high physical workload encompassing sudden loads (13), frequent bending and twisting of the trunk and heavy lifting (9,14), all established risk factors for LBP.

A combination of LBP risk factors related to patient handling and psychosocial problems was found in a prospective study of Norwegian nurses' aides. Predictors of intense LBP and LBP related sick leave were frequently positioning patients in bed, frequent handling of heavy objects at work, medium levels of work demands, perceived lack of support from superior, perceived lack of a pleasant, relaxing, supporting and encouraging culture in the work unit, working in a nursing home and working in night shifts (15).

Poor patient handling skills and high physical workload have also been identified as risk factors for back injuries among student nurses (16). Thus, in a 7.5-year follow-up study of students entering

nursing school, the incidence of LBP increased sharply during and after nursing school attendance (17).

The relationship between physical capacity and the risk of LBP, however, has been questioned.

In a recent review on 24 studies reporting on the longitudinal relationship between physical capacity and the risk of low back pain, the results supported that there is no relationship between trunk muscle endurance and the risk of LBP. Inconclusive results were obtained regarding the relationship between trunk muscle strength and mobility of the lumbar spine and the risk of LBP, due to inconsistent results in multiple studies (18).

A reduced reaction time of the lumbar muscles will theoretically decrease the physical load on the spine in situations where sudden loads occur, e.g patients falling, stumbling or making unforeseen movements. Sudden unexpected loads can lead to high compression forces on the lumbar spine and may increase the risk of LBP and injuries (10).

A high body mass index (BMI), and particularly obesity, has been implicated as another risk factor of LBP (12).

Some studies have indicated an association with psychological and psychosocial factors in the risk of LBP among nursing staff, (19,20) while other studies have not reproduced these findings (21,22). Psychological factors, especially those related to distress or depressed mood, have been implicated in the transition from acute to chronic LBP (11). The stress-coping model related to LBP suggests that stress could have a negative impact on LBP status, either 1) indirectly, through the negative response it produces, which can cause biological or behavioural changes, or 2) through biological or behavioural changes that, in themselves, may have a negative influence on the emotional response (23).

In the health care sector in Denmark, great efforts have been made to meet the recommendations to control the manual handling risks when health care staff is handling patients, with adequate staffing levels, supervision and training in addition to investments in assistive technologies. However, low back pain among health care staff is still a substantial health problem (24, 25).

### **Sickness absence and low back pain**

Musculoskeletal disorders (MSD) (26) and a poor psychosocial work environment (27, 28) are among the most common risk factors for sickness absence.

Non-specific LBP accounts for roughly half of all sickness absence due to musculoskeletal conditions (29, 30, 31, 26).

Two studies showed that a heavy physical workload was associated with sickness absence due to LBP (32,27). Job stressors (32) and low job satisfaction were also associated with an increased risk of sickness absence due to LBP (27).

Psychosocial work environment exposures such as low job satisfaction, low decision latitude, lack of control and high demands influences sickness absence (27, 28, 33, 34, 35, 36). Some of the sickness absence that can be ascribed to a poor psychosocial work environment is associated with mental health problems, stress, anxiety or depression (37, 38, 36, 34).

Predictors of more than three days of sickness absence among nurses' aides were lack of an encouraging and supportive culture in the working unit (39). In a review, long working hours, job strain, low decision latitude, low social support from colleagues, unclear management and role ambiguity were factors associated with poor mental health and sickness absence among nurses' aides (40). Among public sector service employees, low satisfaction with psychosocial work conditions was associated with increased levels of sickness absence (41). The adjusted total number of sickness absence days was 30.8% lower in the most satisfied group compared to the least satisfied group (41).

Global health measures i.e. self-rated health have been shown to be predictors of sickness absence (42). Personal factors such as increasing age, female gender, smoking and frequent alcohol consumption, have also been shown to predict sickness absence (42, 33). Sickness absence is not simply an indicator of ill health, but may also be a coping strategy of the employee to handle reduced work ability caused by illness, adverse situations at work or private life (43).

Social circumstances outside work have also been shown to be associated with sickness absence: need for recovery from staying home with sick children among women, and adverse life events and divorce among men (43).

Sickness absence among staff in the health and social sector in Denmark is high (24). Among Swedish nurses 16% had sick leave spells of 28 days or longer (44). Compared to other sectors in Denmark, staff in the social and health care sector had an average sickness absence rate of 18 days per year in 2006, the central government area had 8.3 days per employee per year and the private sector had 8.1 days per employee per year. Among staff in the social and healthcare sector sickness absence lasting more than three weeks was due to problems in the musculo-skeletal system in 26% of all cases and stress and cooperation problems in 18%. Sickness absence lasting less than 21 days was often due to airway infections.

### **Low back pain prevention programs**

#### **Stress handling and low back pain**

Three different prevention strategies for LBP was combined in the multidisciplinary intervention in this study: stress management, physical training and patient transfer techniques with the purpose of designing an integrated program.

In a study among female nurses' aides and assistant nurses, two different prevention programs on (1) reported neck, shoulder and LBP and (2) perceived physical exertion at work and perceived work related psychosocial factors were evaluated. The participants were randomly assigned to either an individually designed physical training program or workplace stress management program and control group. The results showed improvements in LBP prevalence up to 18 months in the intervention groups. Dissatisfaction with work related psychosocial factors were increased in all three groups (45).

Implementation of a health prevention program on subjective health complaints, including 12 weeks of stress management, physical exercise and an integrated health program among 860 employees resulted in no significant effect on subjective health complaints, sick leave or job stress. However, the stress management group showed improved stress management while the physical exercise group showed improved general health, physical fitness and less muscle pain (46).

#### **Physical training and low back pain**

Physical training in the treatment and prevention of LBP has been investigated in patient populations as well as in occupational settings. Exercise seems to be effective in decreasing pain and improving function among adults with chronic LBP. In acute LBP, exercise is as efficient as either no treatment or other conservative treatments (47,48). In sub-acute LBP populations, some

literature suggested that graded activity programs improve absenteeism outcomes. Physical exercise programs effective in the treatment of chronic LBP included strengthening or trunk stabilizing exercises (47, 49).

In occupational settings, exercise programs used in the prevention of LBP have mainly been focused on back extension endurance programs, but also training programs with the aim of improving the response to sudden trunk loading have been used.

A review on the relationship between physical capacity and the risk of LBP, showed no relationship between trunk muscle endurance and the risk of LBP (18).

Low isokinetic extension strength, poor standing balance and low performance in test of mobility among workers with previous LBP were associated with future back disorders (50).

A worksite physical exercise intervention among home care workers showed that the intervention group had improved physical capacity. The control group experienced an early decline in work ability that was three times faster compared to the intervention group during five years of follow-up. Work ability was based on a self-reported estimation of the physical and mental job demands, actual work ability, number of actual diseases, the subjective prognosis for work ability after two years and sickness absence during the last 12 months (51).

Among nursing staff a weekly physical exercise program showed no effect on perceived organizational/ psychosocial or physical work conditions (52).

The ability to react appropriately and with a short latency when exposed to sudden trunk loading is important for the prevention of LBP (53, 54, 10, 55).

Cholewicki *et al.* (56) demonstrated that an impaired reflex response to sudden trunk loading in previously healthy subjects increased their future risk of subsequent low back injuries. In an intervention study among healthy employees working in a geriatric ward (orderlies, nursing aides, physiotherapist, occupational therapist) the results showed that after 9 weeks of training 2 hours per week, the reaction to sudden unexpected trunk loading was significantly improved (10).

### **Patient transfer techniques and low back pain**

The transfer of patients may include sudden as well as more prolonged loads on the spine.

Until now teaching patient transfer techniques has been the most common approach to preventing LBP and low back injuries among health care staff (57, 58, 59). Previous ergonomic interventions among health care staff alone have not been effective in the prevention of LBP (60, 61, 62, 63, 64). Combined interventions of manual handling and exercise have shown a preventive effect on LBP. Alexandre *et al.* (65) examined a manual handling and exercise intervention and found a reduction in LBP frequency and intensity, while Linton *et al* (66) combined a manual handling exercise, lifestyle management and risk assessment and found a reducing effect on LBP intensity.

However, a recent study among nurses comparing transfer technique instruction in combination with physical fitness training, transfer technique alone and a control group following usual practice showed no overall effect on the occurrence of LBP, but the group that received the combined transfer technique/physical training program significantly improved on disability due to LBP. The study was unfortunately weakened by a high withdrawal rate (67).

### **Prevention of sickness absence**

Tveito and Eriksen (68) investigated healthcare workers and found no statistically significant effect on sick leave or health related quality of life (SF-36) when evaluating a health program including physical exercise, stress management training, health information and an examination of the participants' workplace. However, the sample size of that study (40 in total) might have been too small to show any statistically significant findings in the SF-36 scales.

Workers with no or minimal sickness absence due to LBP had, when they acquired acute LBP, reduced work absenteeism when they were referred to a combined cognitive behavioural intervention and a preventive physiotherapy program (69).

Shi L. (70) evaluated an integrated program for prevention of back injuries for employees in a Californian county including education, training, physical fitness activities and ergonomic improvements. The results showed a decline in costs (including sickness absence) and new episodes of low back pain.

In a RCT on work-related disability in non-specific LBP among employees who were recently on sick leave due to LBP, the results showed that adding problem solving therapy to behaviour graded activity, physical training, back school and lifting techniques had a significant reducing effect on

sick leave six months after the intervention. In addition, more returned to work and fewer received disability pensions a year after (71).

In a recent review on health promotion and sickness absence by Kuopalla *et al* 2008, (72) the results showed that activities involving exercise, lifestyle and ergonomics are potentially effective in preventing sickness absence, but psychological interventions alone did not seem to be effective.

The earlier intervention studies aiming at preventing LBP among health care staff, have targeted nurses, nursing aides, assistant nurses and home care helpers working in the health care service. No previous interventions have targeted assistant nursing students while they are attending their health and social care education. Previous intervention studies have primarily comprised patient transfer techniques alone and only very few studies have, in addition, integrated physical training or stress management.

A combination of stress management, physical training and patient transfer techniques are combined in the multidisciplinary intervention program in Health and Social Care Education (HSCE). To our knowledge this is the first study that combines all three dimensions among nurse assistant students.

## **7. Study Aims**

The overall aim of the study was to evaluate the effect of a multidisciplinary intervention program for stress handling, physical training and patient transfer techniques in health and social care education (HSCE) on LBP prevalence and sickness absence during a 14 month follow-up period (the duration of the education). Furthermore, to evaluate whether the intervention reduced the dropout rate from the HSCE.

In detail the aims were:

- 1) To evaluate if a multidisciplinary intervention program combining physical training, patient transfer techniques and stress handling helps prevent sickness absence among NA students.
- 2) To evaluate if a multidisciplinary intervention program combining physical training, patient transfer techniques and stress handling helps prevent low back pain among NA students.
- 3) To explore if a recent low back pain (LBP) history is a predictor of dropout among NA students taking into account conventional risk factors for LBP, general health and physical fitness.
- 4) To explore if subgroups of students have more benefit than others from the multidisciplinary intervention program on sickness absence.

## **Hypothesis**

- 1) A multidisciplinary intervention program will reduce sickness absence among NA students.
- 2) A multidisciplinary intervention program will reduce the one-year incidence of LBP among NA students.
- 3) The expectation is that the stress preventive effect of a multidisciplinary intervention program is mediated by improved scores of perceived general health and mental health assessed by the SF-36 scales.
- 4) A multidisciplinary intervention program will enable more NA students to complete the HSCE.

## **8. Methods**

### **Design**

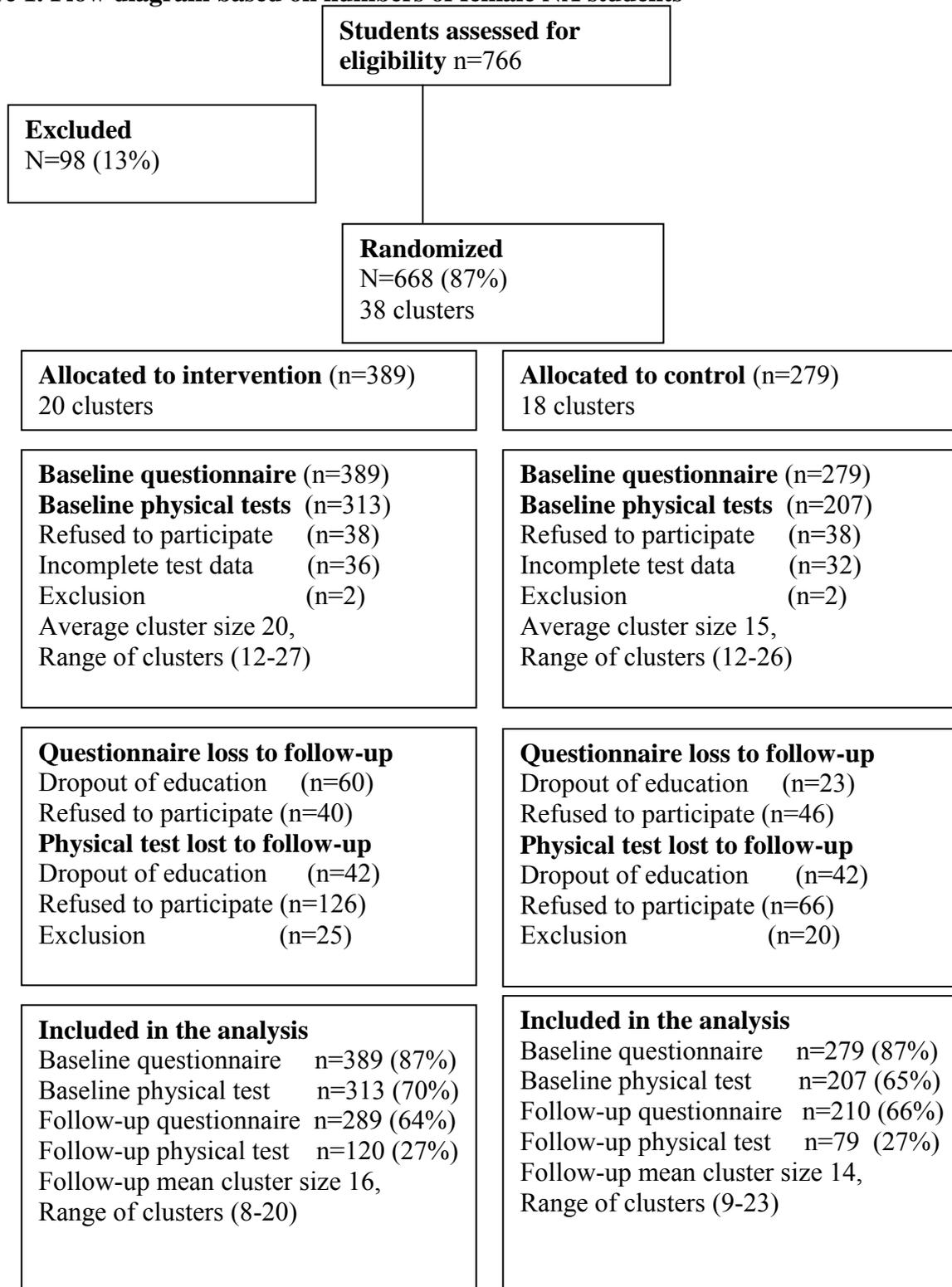
The study was a cluster randomized controlled prospective study with 14 months of follow-up (the duration of the education). The study was conducted in 2004-05. Of 906 students invited, 790 (87%) participated in the study, 413 from the health and social care education program (HSCE) in the Copenhagen City District and 377 from the HSCE in the Copenhagen County District. At both schools, classes were allocated randomly, resulting in 519 students being assigned to the intervention group (20 clusters) and 387 students to the control group (18 clusters). The inclusion criterion was that the student was assigned to one of the allocated classes. The study was single blinded. The teaching teams were separated so that the teams either taught the intervention classes or the control classes, to avoid bias. It was not possible to blind the NA students receiving the intervention. Data was collected in two sessions, in the first week of the NA education (baseline) and the week before the last exam (follow-up). At baseline, all participants completed a questionnaire and were invited to participate in a performance based test session. In addition a sub-sample completed a sudden load test. The same questionnaire and physical tests were completed at follow-up. All participants gave written informed consent. Ethical approval was granted by the Copenhagen Research Ethics Committee (ref. no: 2003-41-3508).

The HSCE program alternates between theoretical modules at the school (1/3) and practical training in nursing homes or in the homecare service. The multidisciplinary intervention program consisted of an integrated approach of three preventive measures, combining physical training (48 hours), patient transfer techniques (20 hours) and stress management and personal development (22 hours). It was only the intervention group who received the intervention program. The control group followed the standard education. The intervention group also received the program during the training periods.

### **Study population**

At baseline, 766 female NA students were invited to participate in the study; 668 (87%) completed the questionnaire (Figure 1). 122 male NA students completed the questionnaire, but they were not included in the flow diagram. The response rate among women at follow-up was 65% (n=499). At baseline, the mean (range) cluster size among women in the intervention and control group was, 20 (12-27) versus 15 (12-26), respectively.

**Figure 1. Flow diagram based on numbers of female NA students**



## 9. Measurements

### Questionnaire

Questions about the main variables used in the study were selected among those developed by The National Research Centre for the Working Environment, Denmark (73).

The assessed test-retest reliability of those questions, selected items on general health perception, mental health, vitality, sense of coherence and self-efficacy were investigated. Pearson's product-moment correlation and Kendall's rank order correlation coefficient were used in a pilot study including 12 NA students. The results showed high test-retest reliability with person correlation coefficients ~0.8 (range .58-0.98) for questions answered with a 14-day interval (74).

### Variables

Low back pain (LBP)	Questions concerning LBP was taken from the Standardized Nordic Musculoskeletal questionnaire (75,76). LBP was defined as tiredness, discomfort or pain in the low back region with or without symptoms radiating to one or both legs during the previous 12 months (primary outcome) or during lifetime (secondary outcome) (77).
Sickness absence	Sickness absence was self-reported. The question was phrased "how many days during the last 12 months have you been absent due to your own sickness?" (33).
Health care use	The item on health care use was phrased "because of LBP in the last 12 months have you "1) stayed at home, 2) been unable to participate in sports or other leisure time activities, 3) contacted a physiotherapist, 4) contacted a physician, 5) contacted a chiropractor or 6) done something else? (73). There were multiple answer options but in the analysis we focused on whether the subject had contacted a physician or not.
Heavy physical workload	An exposure history of too heavy physical work was defined as having had a physical demanding job for at least 6 months. Occupations considered physically demanding were homecare

worker, orderly (hospital attendant having general, non-medical duties), removal worker, warehouse worker, metalworker, slaughterhouse worker and fisherman.

Leisure time physical activity (LTPA)	Current smoking and leisure time physical activity (LTPA) (78) were included as lifestyle factors. The participants classified themselves as belonging to one of four categories from definitely sedentary to physically active, i.e. performing vigorous physical activity for at least 4 h/week.
Socio-demographic variables	We included variables on age, gender, and country of birth.
Education	Years of completed schooling was included as a marker of social class and participants were divided in two groups, those having completed $\leq 9$ years of schooling and or $> 9$ years. The mandatory minimum education in Denmark is 9 years, with children commencing school when they are 6-7 years old.
General health perception	General health (GH), Vitality (VT) and mental health (MH) scales were measured by the SF-36 health perception scales, score range from 0-100, with higher scores representing better health (79).
Psychosocial concepts	Psychosocial concepts were assessed with Setterlind's modified nine-item scale of sense of coherence scale (SOC) (80, 81) and Banduras scale on self-efficacy (SE) (82, 83).
Satisfaction with the education	A question with five response options on satisfaction with the education was phrased: "How satisfied are you with your education overall?"
Dropout	Information on dropout from NA education was based on the schools' records.

## 10. Physical tests

The following fitness markers were measured: balance, flexibility of the spine, back extension and back flexion endurance. To do so, we conducted a 90 minute session.

### Physical tests

**Isometric back extension endurance test** The isometric endurance of the back muscles was measured using a modified version of the Sørensen test (84). The subjects were placed on their stomach with their navel over the edge of a padded sloping board, which was 70 cm in length and 15 cm high at the raised end. The subject's feet were pressed down to the floor by an assistant. The hip flexion was approximately 12° during the test. To pass the test the subject should be able to fold the arms across the chest and hold this position for 180 s. The reliability of this test has been reported as good, showing intraclass correlation coefficients (ICCs) of 0.82-0.96 (84, 85).

**Isometric back flexion endurance test** Isometric back flexion endurance was measured using the test described by McGill (86). The subject was positioned in a sit-up posture, with the back resting against a jig angled 60° from the floor. The arms were folded across the chest, and the knees and hips were flexed at 90°. The jig was pulled back 10 cm and to pass, the subject is required to hold the isometric posture for 180 s.

**Saggital flexibility test** Saggital flexibility, defined as the distance from the fingertips to the floor, was measured by the modified finger-to-floor method (87), in which the subject flexes the spine maximally, without bending the knees while standing without shoes on a 30-cm measuring box. The test reliability was reported as good, ICC=0.93. (88)

**Balance** Balance was evaluated by the one-leg standing test, testing the ability to stand on one leg with the eyes open for 60 s. The test reliability has been reported as ICC=0.76 (89).



giving the individual a toolkit for experiencing control. The sessions comprised theoretical exercises and group discussions.

### **Physical training**

Each training session consisted of 15 minutes of warm-up including exercises that enhanced back muscle extension endurance and back muscle flexion endurance. This was followed by 45 minutes of exercise focusing on expected and unexpected trunk loading and balance. The difficulty and intensity of the program was adjusted to each subject and increased progressively during the training period. The subjects were trained by a physical training instructor. Three to five sets of 30-60 seconds were normally used for each exercise depending on the intensity. For continuous jumping exercises maximally 3 to 4 sets of 30 seconds were performed (92).

### **Patient transfer techniques**

The patient transfer technique program consisted of both theoretical education and practical exercises (93). The program was based on principles from a Norwegian method (Per Halvor Lunde), focusing on the main laws of physics (gravity, friction and lever-arm principles) and the use of human natural movement patterns of moving one body part at a time (67). The technique includes using transfer aids and the functional capacity of the patient during the transfer situation. The method adds to the basic principle of work technique (keeping the back in a vertical and neutral position, using the legs in weight transfer and adjusting working height). The technique also includes biomechanics, found to reduce the biomechanical load on the low back by decreasing the compression forces at L4-L5 (94, 93).

The NA students were trained in patient transfer techniques by an experienced ergonomic physiotherapist, who taught the concept of transfer technique and practised basic skills. Five selected transfer situations were trained moving the patient 1) towards the head of the bed, 2) from lying in bed to sitting on the edge of the bed and 3) vice versa, 4) from sitting on the edge of the bed to sitting in a chair, and 5) vice versa.

### **Power calculations**

A set of a priori power calculations was made separately. Based on 95% power to detect a significant difference of 20% in the physical tests ( $p=0.05$ , two sided), 407 subjects in each group (814 in total) were required for each intervention group. To have an 80% chance of detecting a

significant ( $p=0.05$ , two sided) five-point difference between the two groups in the mean SF-36 general health perception scores, with a correlation of 0.6 between repeated measures, 168 (336 in total) in each group were required.

## **11. Statistical tests**

The statistical analyses were performed using The Statistical Package for the Social Sciences, Version 14.0 (SPSS version 14.0). Mixed effect models were analyzed with SAS statistical software version 9.1 (SAS Institute Inc., Cary, NC, USA).

The majority of the analyses were performed on women.

Basic comparisons of groups were performed using the chi-squared test (likelihood ratio), Students unpaired *t*-test or Mann Whitney rank-sum for categorical and continuous variables respectively.

Correlations were estimated with Kendall's correlation test (ranks).

A *P*-value of 5% was considered significant.

Quartile cut points for the SF-36 subscales were chosen from a normal Danish female population, age range 25-34 years, cut points for the lowest quartiles, low GH  $\leq 77$ , low MH  $\leq 77$  and low VT  $\leq 55$ . (79).

For analysis of covariates associated with dropout, a logistic regression analysis was performed. Stepwise backward elimination of variables and the maximum likelihood method was used, accepting a priori variables with *P*-values  $< 0.10$  as obtained in the univariate analyses. The exit criterion for the variables in the logistic regression analysis was a *P*-value  $> 0.1$ . Odds ratios are presented with 95% confidence limits.

The effect of the intervention on outcome measures at follow-up was analyzed according to the intention to treat principle, including all subjects regardless of whether or not they actually received the complete intervention.

The analysis was conducted with all available respondents at the time of follow-up, using mixed effect models with the interventions as fixed effect, and taking into account random variation between students in the same cluster and between clusters. All mixed effect models were adjusted for cluster and age (SAS, version 9.1 procedure mixed). The models including continuous variables were also used to calculate the intraclass correlation coefficient in order to compare the variation between clusters to the total variation. The effect of the intervention on the dichotomous health measures at baseline were analyzed with logistic regression models adjusting for age and cluster, while the health measures at follow-up, in addition, were adjusted for the baseline values.

The logistic regression models of predictors of sickness absence and the subgroup analyses were performed using the proc logistic procedure (SAS, version 9.1) with stepwise elimination of variables and the maximum likelihood method, accepting a priori variables with  $P$ -values  $<0.5$  as obtained in the univariate analyses. The exit criterion for the variables in the logistic regression analysis was a  $P$ -value  $>0.1$ . Odds ratios are presented with 95% confidence limits.

## **12. Results**

The non-responder analysis of those lost to follow-up, showed that non-response was neither associated with LBP, sickness absence or intervention status. There were no significant differences in demographic features between the intervention and control group (Table 1). Nurse assistant students were relatively old when they began the HSCE program. The mean age of the study population was 33 (SD=10), range (17-61) years and 668 (83%) were women. Seventy three percent were born in Denmark. Less than 9 years of schooling was reported by about 25% and about 36% had previously been exposed to heavy physical workloads. The mean BMI was 26. Only 36% were light physically active  $>4$  hours a week. The rest of the sample was physically passive. Smokers comprised 48% of the population.

### **Health and psychosocial characteristics at baseline**

The distribution of the scores on SF-36 subscales: perception of general health (GH), vitality (VT) and psychological well being (MH) at baseline are presented in Figure 2. The distribution of the GH, VT and MH scales are bell shaped around the mean value. The proportion of NA students with a GH score  $\leq 77$  was 45% compared to 25% among females in the same age range (25-44 years) in the general Danish population. This indicates that the female NA students in the study had a poorer health status when they began their health and social care education compared to females in the same age range in the general Danish population. NA students scoring low on the MH and VT scales, have corresponding findings as among females in the general Danish population.

Correlations between baseline covariates were analysed using a correlation matrix in order to investigate co-linearity. An especially high correlation was found between vitality and mental health. The correlation coefficient was 0.38,  $P < 0.01$ .

**Table 1. Baseline characteristics of the study population.**

	Intervention 389 (58%)	Control 279 (42%)
	Mean (Standard Deviation)	Mean (Standard Deviation)
Sickness absence during the last 14 months (days)	6 (13)	6 (21)
Psychosocial factors (SF 36 subscales)		
GH <sup>a)</sup>	79 (16)	79 (15)
Vitality <sup>a)</sup>	69 (17)	70 (16)
MH <sup>a)</sup>	77 (16)	81 (13)*
SE <sup>b)</sup>	30 (5)	30 (5)
Age (range 17-61 years)	32 (10)	33 (11)
BMI	26 (5)	25 (5)
Previous history of LBP	<i>n</i> (%)	<i>N</i> (%)
12 month prevalence of LBP	148 (39)	119 (44)
Self-rated health awareness, high	377 (98)	265 (97)
Take care of health	279 (98) <sup>c)</sup>	204 (98) <sup>c)</sup>
Health care use <sup>d)</sup>	61 (36)	37 (27)
13. Exposure history		
Heavy physical workload <sup>e)</sup>	135 (36)	88 (34)
LTPA		
Light physically active > 4 h a week	137 (36)	102 (38)
Performance based physical fitness		
Isometric back extension endurance (% passed 180 s)	175 (56)	114 (55)
Balance (% passed 60 s)	286 (82)	200 (86)
Other characteristics		
Satisfaction with the education	377 (98)	265 (97)
Country of birth, Denmark	280 (73)	197 (73)
Education, <9 years of schooling	94 (25)	58 (21)
Smoking	192 (49)	132 (48)

<sup>a)</sup> Range (0-100).

<sup>b)</sup> Range (0-40).

<sup>c)</sup> The number of cases in each analysis varies due to different levels of missing on the different questionnaire items.

<sup>d)</sup> Consulted a physician because of low back pain.

<sup>e)</sup> History of exposure to heavy physical workload >6 months.

Chi-Square test: likelihood ratio and Students t-test was used when appropriate. \* $P < 0.05$ .

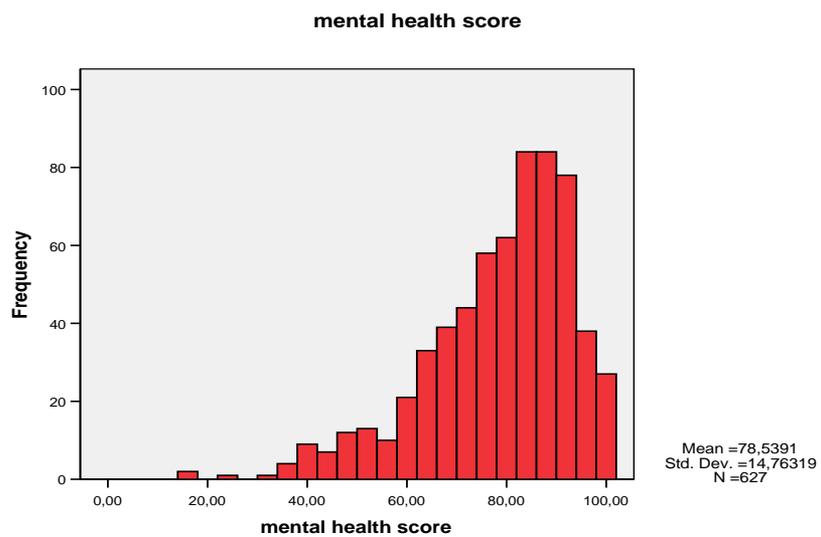
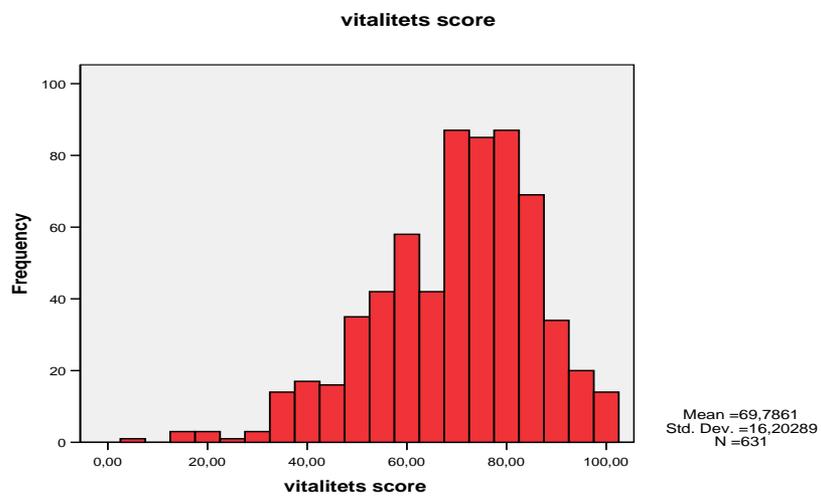
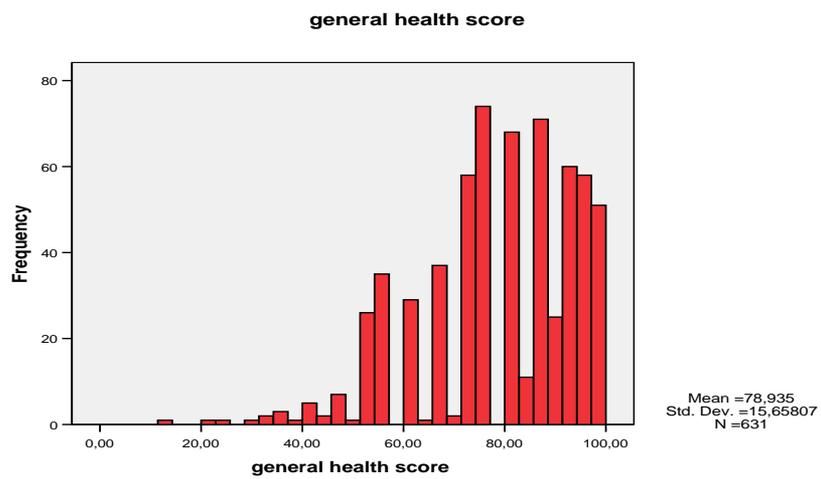


Figure 2. Distribution of baseline SF-36 subscales on general health, vitality and mental health among female NA students.

NA students with self-reported LBP during the past year had significantly lower SF-36 mean scores: GH, VT and MH. Among NA students with LBP, there were significantly more subjects in the lowest quartiles of MH and VT. When the analysis was stratified for gender, a similar pattern was found for women, while there was no significant difference between subjects with and without LBP in men.

### **Dropout from the health and social care education**

The overall dropout rate for the HSCE program was 29%. Overall, however, there was no difference in the one-year prevalence of LBP between the NA students who dropped out and those who completed the program.

The following results applied only to women. As mentioned they comprised 83% of the study population. There was no difference in age among those who completed the study and those who dropped out. Women who dropped out more often had a history of heavy physical work, a lower proportion passing the isometric back extension endurance test, a lower proportion passing the balance test and a lower MH score.

A recent LBP history was not an independent single predictor of dropout. We found an increased risk of dropout among women who had previously been exposed to heavy physical work, OR (95% CI) =1.6 (1.1-2.4) (Table 1). The association between dropout and passing the back extension endurance test was OR (95% CI) =0.6 (0.4-0.98). A MH score >72 was found to be associated with a lower risk of school dropout, OR (95% CI) =0.52 (0.31-0.93). The model was adjusted for the confounders' age, height and years of schooling. No other risk factors for dropout than lower height could be identified among men.

We estimated the population attributable risk (PAR) for a low MH score. Assuming that all participants had a MH score above the lowest quartile (<72), theoretically, as a point of estimate 20% of the dropout would not have occurred. Corresponding estimates of PAR for heavy physical workloads and insufficient back extension endurance were 16 and 22%, respectively. Female NA students with LBP had an increasing risk of discontinuing their education when an increasing number of risk factors were present. When two or more of the above mentioned risk factors were present, recent LBP was significantly associated with dropout, OR (95% CI) =2.5 (1.2-5.3).

With no non-LBP risk factors present the dropout rate was 19% and with one of the non-LBP risk factors present, it was 25%. With two or three risk factors present, the dropout risk was 39%. We

included the risk factor index according to dropout in a logistic regression model and found significant interaction OR (95% CI) =1.32 (1.02-1.72).

**Table 2. Covariates significantly associated with dropout among NA students after adjustment in a logistic regression model. Variables are presented according to statistical strength of association with dropout after adjustment. Odds ratios for dropout (OR) with 95% confidence limits are presented for variables in the adjusted models (p<0.10).**

Predictor	Women <sup>1)</sup>	P	Men <sup>2)</sup>	P
	(n=429)		(n=101)	
	OR		OR	
	CI		CI	
<b>Predictor</b>				
Heavy physical workload <sup>a)</sup>	1.6 (1.1-2.4)	*		
Isometric Back Extension Endurance (%Passed 60 sec)	0.6 (0.4-0.98)	*		
<b>Mental health<sup>b)</sup></b>				
Lowest quartile (≥16-72)	1 (reference)			
Intermediary quartiles (>72-88)	0.52 (0.31-0.87)	**		
Highest quartile (>88-100)	0.57 (0.35-0.93)	*		
Height (cm)	-		0.94 (0.80-0.90)	*

1) Excluded in the model, one-year prevalence of LBP, Age, Height (cm), ≤9 years of schooling, flexibility (cm below floor level), self-efficacy and VT in low, intermediary and high quartiles. 2) Excluded in the model, one year prevalence of LBP and age. \* P<0.05, \*\* P<0.01 and \*\*\*P<0.001. <sup>a)</sup> Heavy physical workload> 6 months. <sup>b)</sup> Range (0-100).

### **Low back pain and sickness absence at baseline and follow-up**

We found a 12-month prevalence of LBP of 38% at baseline. Subjects with LBP were on average taller compared to those without, 168 (SD=8) cm versus 166 (8),  $P<0.01$ . Among subjects with LBP during the past year, 42 versus 33%,  $p<0.05$ , had previously been exposed to heavy physical work. NA students with LBP had lower flexibility of their spines, compared to those without LBP. They also had a lower proportion passing the isometric back extension endurance test and back flexion endurance test.

The prevalence of LBP increased in the intervention and the control group at follow-up, 139 (50%) and 110 (53%). At follow-up the intervention group had to a slightly lesser extent consulted a physician because of LBP, 28% versus 33 %,  $p=0.08$ .

Sickness absence at baseline was mean (standard deviation), 4 (8) and 5 (12) days, in the control and the intervention group, respectively. The median sickness absence was 10 days in both groups at follow-up. Sickness absence increased in both groups at follow-up, but this increase was significantly lower in the intervention group, 12 (20) versus 18 (34) days, (estimated effect difference 5.92,  $p<0.05$ ), as shown in Table 3.

The increase in sickness absence was significantly higher in the control group compared with the intervention group, mean difference (standard deviation) 9 (48) versus 5 (14) days,  $p<0.05$ .

### **General and mental health at baseline and follow-up**

The intervention group reported no change in their mean level of general health perception (GH), energy/fatigue (VT), or psychological well being (MH) at follow-up, while the control group reported a decline on these scales. At follow-up, GH in the intervention group was significantly higher compared to the control group, 80 (15) versus 75 (17), respectively, with an estimated effect difference of  $-3.7$ ,  $p<0.01$ . VT in the intervention and the control group at follow-up was 68 (17) and 63 (18), (estimated effect difference  $-4.69$ ,  $p<0.01$ ). MH in the intervention and the control group at follow-up was, 80 (13) and 74 (17), (estimated effect difference  $-3.94$ ,  $p<0.05$ ). The intra-class correlation coefficients on sickness absence, GH, VT or MH were close to zero, indicating that the variation within clusters was greater than between clusters.

**Table 3. Outcome measures at baseline and after 14 months of follow-up in the intervention and control group and the estimated effect of the intervention.**

	Intervention Group, <i>n</i> (%), 372 (58)	Control Group, <i>n</i> (%), 266 (42)	Intraclass Coefficient	Estimated Effect Difference	95% Confidence interval
	Mean (SD)	Mean (SD)			
Sickness absence during the last 14 months (days)					
at baseline	5 (12)	4 (8)	0.020	-0.50	(-2.3 - 1.3)
at follow-up	12 (20)	18 (34)	0.000	5.92*	(1.1 - 10.8)
GH <sup>a)</sup>					
at baseline	79 (16)	79 (15)	0.001	0.11	(-2.4 - 2.6)
at follow-up	80 (15)	75 (17)	0.004	3.7**	(-6.5 - -0.9)
Vitality <sup>a)</sup>					
at baseline	69 (17)	70 (16)	0.000	0.65	(-1.9 - 3.2)
at follow-up	68 (17)	63 (18)	0.020	4.69**	(-8.0 - -1.4)
MH <sup>a)</sup>					
at baseline	80 (12)	77 (15)	0.000	3.11**	(0.8 - 5.4)
at follow-up	81 (13)	74 (17)	0.070	3.94*	(-7.7 - -0.2)
12 month prevalence of LBP	<i>n</i> (%)	<i>n</i> (%)		Odds ratio	
at baseline	281 (39)	273 (44)		0.8	(0.6 - 1.1)
at follow-up	278 (50)	209 (53)		0.9	(0.6 - 1.4)
Health care use <sup>b)</sup>					
at baseline	169 (37)	137 (28)		0.49	(0.2 - 1.1)
at follow-up	161 (28)	122 (33)		1.4	(0.9 - 2.2)

<sup>a)</sup> Range (0-100).

<sup>b)</sup> Consulted a physician because of LBP.

Effect difference was adjusted for age, gender and cluster.

P-values for the mixed effect model: \*p<0.05, \*\*p<0.01.

### **Predictors of sickness absence**

A logistic regression analysis of predictors of more than 10 days of sickness absence days at follow-up appears from Table 3. The full model showed that NA students in the intervention group had a decreased risk of more than 10 days of sickness absence OR (95%CI) = 0.6 (0.4-0.98). Likewise those who did not take care of their own health were associated with more than 10 days of sickness absence at follow-up, OR (95%CI) = 2.1 (1.1-4.1), respectively. However, LBP during the last year, MH and GH were not identified as independent predictors of sickness absence. Interactions between the intervention and vitality and taking care of own health were not found.

In the reduced model, more than 10 days of sickness absence at follow-up was associated with a reduced risk in the intervention group, OR (95% CI) = 0.63 (0.4-0.97), having a VT score below or equal to 55, OR (95%CI) = 2.1 (1.1-3.7), not taking care of health OR (95%CI) =2.4 (1.03-4.1) and smoking OR (95%CI) = 1.5 (1.1-2.3).

### **Subgroups who benefited most from the intervention**

Finally, an explorative analysis was performed on subgroups using the reduced model (1) with sickness absence >10 days a year as outcome. The subgroup analysis was conducted on the following groups; GH  $\leq 77$  or  $\geq 78$ , MH  $\leq 72$  or  $\geq 73$  and VT  $\leq 55$  or  $\geq 56$ , smokers versus non-smokers, light physical activity more or less than 4h a week, age (<30 years or 30+ years), taking care of own health yes or no and satisfaction with the education or not.

The results are not presented in the tables. The subgroup analyses were made separately.

Among women who did take care of their own health, a logistic regression model showed that the intervention group had a significant decreased risk of more than 10 days of sickness absence, OR (95%CI) = 0.47 (0.3-0.78). Similar profiles were found among women with a VT score  $\leq 55$ , OR (95%CI) =1.9 (0.9-3.8) and smokers OR (95%CI) =1.7 (1.02-2.7). The likelihood ratio test for the model was significant. In the group of NA students with a VT score above 56, the intervention group had an increased risk of >10 days of sickness absence, OR (95%CI) =0.048 (0.28-0.8). Likelihood ratio test for the model P=0.002. Among women with a high GH score  $\geq 78$ , the intervention group had a reduced risk of more than 10 days of sickness absence OR (95%CI) =0.44 (0.2-0.8). Likelihood ratio test for the model P=0.01. In NA students without LBP the control group also had an increased risk of sickness absence, OR (95% CI) =2.0 (1.08-3.9). Likelihood ratio test for this model P=0.003. We found no interaction in any of the analyses mentioned above.

**Table 4. Baseline covariates significantly associated with sickness absence more than 10 days/year at follow-up among NA students after adjustments in a logistic regression model.**

	Bivariate model	Multivariate models	
	Sickness absence > 10 days (n=375)	Full model (n= 375)	Reduced model (n= 375)
	N (%)	OR (CI)	OR (CI)
Intervention (control group)	110 (52)	0.6 (0.4-0.98)*	0.63 (0.4-0.97)*
General health <sup>a)</sup>	93 (45)	0.9 (0.6-1.4)	
Vitality <sup>b)</sup>	50 (24)**	1.9 (0.9-3.6)	2.1 (1.2-3.7)*
Mental health <sup>c)</sup>	62 (29)	1.1 (0.6-1.8)	
Do not take care of health	37 (18)**	2.1 (1.1-4.4)*	2.4 (1.03-4.1)*
Not satisfied with the education	23 (11)	1.6 (0.7-3.6)	
Smoking	106 (51)*	1.5 (0.97-1.0)*	1.5 (1.01-2.4)*
Leisure time physical activity <4 h. a week	130 (63)	0.9 (0.6-1.5)	
LBP 12 month prevalence	94 (45)	1.1 (0.7-1.8)	
Age	33 (10) mean SD	0.99 (0.97-1.01)	0.99 (0.97-1.0)
BMI	25 (6) mean SD	1.03 (0.98-1.07)	
Country of birth, Denmark	167 (80)	0.8 (0.5-1.4)	
Education, <9 years of schooling	50 (21)	1.1 (0.6-2.1)	
Intervention* Do not take care of health		Ns	
Intervention* Vitality		Ns	

Variables are presented according to statistical strength of association with >10 days of sickness absence after adjustment. Odds Ratios for sickness absence with 95% confidence limits are presented for variables in the adjusted models ( $P < 0.1$ ).

<sup>a)</sup> cut point  $\leq 77$ , <sup>b)</sup> cut point  $\leq 55$  <sup>c)</sup> cut point  $\leq 72$ . \* $P < 0.05$ .

## **14. Discussion**

Some, but not all hypotheses were confirmed. The hypothesis that NA students allocated to the intervention group had a significantly lower sickness absence than NA students in the control group was confirmed in this study. With respect to low-back pain, the one-year prevalence had increased in the intervention as well as the control group, and no difference was observed in the relative increase between the two groups. Furthermore, no significant deterioration was observed in the intervention group regarding general health perception (GH), energy/fatigue (VT) and mental health (MH), whereas in the control group, scores for all these health measures were significantly lower at the time of follow-up, most pronounced for the vitality and mental health items. This is in agreement with the hypothesis that the intervention program prevents stress, resulting in stabilized or improved scores for GH and MH. In addition the same effect for vitality was also found. The intervention program did not prevent dropout from the HBSE and this hypothesis was therefore rejected.

Some selected subgroups of students benefited more from the intervention program on sickness absence than other subgroups: those who took care of their own health, those who had a good perception of general health and vitality and those without LBP.

### **Sickness absence**

The findings of an intervention effect on sickness absence are in accordance with a review on work health promotion and sickness absence by Kuopalla *et al* (72), where exercise and ergonomics were shown to have a preventive effect on sickness absence among different occupations. Only a few studies have investigated the effect of psychosocial interventions in the prevention of sickness absence as we did with some positive results. For example the randomized controlled study including 185 patients seeking care for non-specific LBP or neck pain by Linton *et al* (69) showed that those allocated to a cognitive behavioural intervention had significantly lower work absenteeism during a 1-year follow-up period than a control group. Also the findings of van der Klink *et al.* (95) support the importance of an intervention program aimed at behavioural change. Using what they referred to as an activating intervention, they conducted a prospective, cluster randomised controlled trial that included 192 patients on first sickness leave. Subjects were asked to develop problem solving strategies for their stress courses, put these into practice, and extend their daily activities to more demanding ones. At 12 months all patients had returned to work, but sickness leave was shorter in the intervention group than in the control group (95).

In a multidimensional intervention study among health care workers by Tveito and Eriksen (68), the intervention group showed a tendency to have improved scores on GH and MH. However, this was not analyzed in the paper. The authors concluded that there was no intervention effect on sickness absence and subjective health complaints. In their specific case the sample size was relatively small (40 in total). Therefore a statistically significant effect on the SF-36 scales was not found.

Other similar studies have indicated that SF-scores predict sickness absence. In a study of participants working in the public sector in Sweden, they compared the ability of three different health check-up models to predict sickness absence (96). They concluded that self-rated health with one single question (the first item in the GH SF-36 scale) had a quality in the prediction of sickness absence that was as good as more complicated models including variables of smoking, blood pressure, waist/hip measurements, fitness testing, total serum cholesterol and the relation between low density lipoproteins and high density lipoproteins weighted together, and serum triglycerides. This illustrates that individuals' own perceptions of health capture more aspects of health than even several lifestyle factors in combination with objective biomarkers of health.

Surprisingly, the subgroups that benefited most from the intervention were those who took care of their own health, had good perception of general health and energy and those without LBP.

Increased health awareness among a subgroup of NA students corresponds to studies using the "precaution adoption process model", where awareness of own health behaviour is an assumption for the motivation of people to move from pre-contemplation to a higher state of change (97,98).

The results of the subgroup analysis showed, unfortunately, that the intervention contributed to increased inequality in the pattern of sickness absence among the NA students, instead of helping the disadvantaged to improve their coping capacity and health status, enabling more students to be present at school and follow more classes.

Very little is known about differential intervention effects in health prevention programs. Barriers to identifying or reaching individuals at the highest risk may result in different intervention effects among subgroups (99,8). One reason could be different adherence to intervention programs among subgroups (100, 101).

Recent research on adherence to mammography screening programs, have shown lower participation rates among women with low education, women without contact to a primary care physician and women without dental care (102).

These results indicate a widening in the social inequity in health due to selection and adherence. In our study the question is whether the observed inequality in the pattern of sickness absence is a temporary effect or whether it has a long-term effect. A long-term effect might contribute to the increasing high sickness absence rates observed among nursing assistants working in the health and social care service in Denmark (24).

### **Low back pain**

The intervention program was planned with the intention to prevent LBP, but failed to show an effect, although it included physical training and patient transfer techniques. NA students did not have a higher 12 month prevalence of LBP when commencing their education, compared to the same age range in the general Danish population. The one-year prevalence of LBP had increased in the intervention as well as the control group at follow-up, and no differences were observed in the relative increase between the two groups. This finding is in accordance with the finding from a 7.5-year follow-up study of students entering a school of nursing, showing that the incidence of LBP increased sharply during their nursing school attendance (17).

Although the prevalence of LBP in some studies increases with age (103), the dose response relationship with LBP is not linear, suggesting that multiple factors are involved (104). In the total sample in this study (790 students) the highest frequencies of LBP were found among the youngest age groups. However, the estimates on LBP at follow-up were adjusted for age, and age was not found to have an effect on LBP independently of other covariates in this study. Several studies have investigated the prevention of back pain and injuries among nurses and nurses' aides (64). Only two of these studies, showed an effect on the intensity of LBP. Both studies combined manual handling and exercise and lifestyle counselling, respectively (65,69). A recent intervention study on transfer technique instruction and physical fitness training showed reduced disability due to LBP among nurses, but the occurrence of LBP was not prevented (67). Physical exercise and patient transfer techniques were used in the current intervention also, yet there was no tendency for this combined intervention to prevent LBP.

The relationship between physical capacity and the risk of LBP is not clear (18). Physical training for the specific purpose of improving the response to sudden trunk loading has been shown to reduce the reaction time in the low back muscles. However, among the subgroup of NA students who performed a sudden load test, improved reaction time was not associated with a lower

prevalence of LBP (105). It remains to be investigated if this specific training prevents low back injuries among qualified nurse assistants.

There is no convincing effect of physical training in the prevention of LBP. It has been shown that individuals with high physical fitness may reduce the number of days with LBP, but not the occurrence of pain (106). Physical training for the purpose of improving physical capacity requires a regular and sustained training effort. Furthermore, no consensus exists on which training programs are the most efficient in the prevention of LBP. However, there are generally many beneficial effects of physical training. The point is that it is important to create motivation for the NA students to participate in physical activities for other health prevention reasons than LBP.

Psychological factors play a central role in the transition from acute to persistent or chronic LBP. These psychological factors may enhance or catalyze the problem. This implies that the experienced pain interacts with psychological factors which influence emotion and behaviour and that, in turn, these will shape the course of pain development (107). LBP and concurrent psychological distress showed an increasing prevalence from 2.6 to 5.9% among Swedish women over a 16-year period. The authors concluded that the general population's awareness and perception of LBP and psychological distress might have changed and in turn affected the individuals' willingness to report these symptoms (107). The NA students in this study may have experienced increased awareness of LBP during the study period because much attention is paid to preventing LBP when they are attaining courses and when they are handling patients in the course of training.

The solution in the prevention of non-specific LBP lies in modifying people's attitude and response to pain symptoms as suggested by several researchers (108, 107, 109, 110).

### **Health and psychosocial characteristics**

The intervention program resulted in stabilized scores of general health (GH), vitality (VT) and mental health (MH), as observed in the intervention group, whereas in the control group, scores for all these health measures were significantly lower at the time of follow-up.

The hypothesis was confirmed that the stress preventive effect of a multidisciplinary intervention resulted in stabilised or improved SF-36 scores on MH and GH. The overall goal of the stress management program was to increase energy and motivation among NA students. The expectation was that students characterised by fatigue, i.e. a low VT score, would have benefited from this part of the intervention. This was not the case. As no interaction between vitality and the intervention was found, it is difficult to determine which effect lies behind the findings.

Allocation to the control group, do not take care of health, fatigue and smoking were identified as independent predictors of sickness absence in the current study. When considering explanations for the observed fatigue (a low VT score), other causes than psychological factors e.g hypothyroidism, anemia, vitamin D deficiency or factors related to private life have to be taken into account.

The results indicate that the high sickness absence rates observed might be related to coping strategies directed towards adverse situations in school or private life. LBP, GH and MH were not identified as independent risk factors of sickness absence. This may be an expression of increased psychological vulnerability.

### **Dropout from health and social care education**

No previous studies have investigated dropout among NA students. However, previous studies on dropout among nursing students have focused their exit interviews on study factors and not on individual risk factors. Exit interviews have some methodological problems such as recall bias (4). Respondents may post-rationalize and thus tend to attach more weight to study factors than individual factors.

Leaving reasons such as course content and structure were not found as expected in a study among nursing students. The main leaving reasons were personal problems, disillusionment, travelling and staff attitude during training periods, which affected some students adversely and seriously (11). This is in line with experiences from the HBSCE program in Denmark (3), where a significant part of the dropout occurs during the training periods due to the so-called “practice shock”. A proportion of students will always leave their education for voluntary reasons or failure to progress. The importance of investigating individual factors for dropout is underscored by the high dropout rate in HBCE and the lack of knowledge of the NA students’ individual leaving reasons. Identifying these risk factors will facilitate the possibility of modifying or preventing the identified risk factors. Needless wastage of students from a program, however, may be a costly experience for the schools and therefore there is good reason to identify the problem areas they encounter.

### **Measurements**

#### **Sickness absence**

Sickness absence data were based on self-reports, and this may have introduced recall bias. Imprecision in this respect would only have a diluting effect on the results. In the Whitehall II study, women in general reported less sickness absence over the last year compared to that recorded

in the employers' registers. However, self-reported data on sickness absence have been found to be valid (112,113). According to Marmot M. *et al.* (42) health functioning is a mixture of social, psychological and physical functioning, and sickness absence may therefore serve well as an integrated measure of functioning. If this integrated perspective is considered, then sickness absence may be useful as "end point" when studying healthy functioning also among NA students.

### **Low back pain**

Non-specific LBP is a very common symptom in the general Danish population. Part of the explanation for the observed increase in LBP prevalence in this study may be the general high awareness on the prevention of LBP during transfer technique instruction in the HBCE program and in the social care area when the students are in training. Choosing the one-year prevalence of LBP as outcome has some limitations since it is not possible to graduate. The question is also if the one-year prevalence is suitable as an indicator of an intervention effect, since it is a common symptom in the general population with several risk factors and it is not possible to graduate.

No intervention studies to date have been able to prevent the occurrence of LBP (64, 67), which is in line with the findings of this study. They have only been able to decrease pain intensity and disability related to LBP.

It might have been a better, but time consuming solution, to use log books, where the students could register low back pain symptoms during the week, to be able to graduate the prevalence (114).

Physical workload was based on self-reports of type and duration of occurrence. This question was unfortunately not validated in terms of different physical work-load levels since the questions used do not measure this.

The experience from the physical training lessons was that, on average, 30-50% of the NA students in a class participated in the training, and it was sometimes hard to motivate them to participate. It is possible that the students' performance of the physical training program and the patient transfer training were not adequate. A regular training effort is required to obtain a training effect as measured by the physical test. Lack of participation in the training program might be the reason why an effect on back extension endurance was not observed. This may dilute the effect of the intervention. With the aim of minimizing potential bias in the collection of the physical test data, we used five experienced test leaders. The test leaders had no information on the participants regarding current smoking, LTPA level and history of heavy physical work before the testing. Subjects were kept unaware of the specific hypothesis under investigation. At follow-up the participation in the

physical tests was low. This might have diluted our results due to selection bias, since a possible difference between the groups were not detected.

### **General health perception, vitality and mental health**

Health status was measured with the SF-36 subscales on GH, VT and MH. The Danish version of SF-36 has shown to have adequate internal validity, internal consistency and a factor structure that resembles the U.S. version (115).

The general health perception scale (GH) is a strong independent predictor of morbidity and mortality (28, 116, 117). General health with one single item from the GH scale, ‘How do you rate your health in general?’ with five response options (very good, good, fair, poor, and very poor) has also been used as a predictor of sickness absence (33, 96).

The vitality scale is considered to be a subjective measure of general well-being. The combination of items in the scale is intended to capture positive health states (energy) as well as somatic expressions of physical illness (fatigue) (118). Persson evaluated clinical validity of SF-36 among Swedish women and found the vitality scale to be moderately to substantially correlated with both physical and mental health. However, it was more correlated to the mental dimension, compared to a corresponding U.S. study (119). As in Persson’s study, we also found the vitality scale to be correlated with the mental health scale. The mental health scale measures aspects of anxiety and depression. Low scores represent feelings of nervousness and downheartedness and high scores represent calmness, peacefulness and satisfaction.

The SF-36 subscales had a good discrimination of general health, mental health and vitality in the population. In addition the study had sufficient statistical power to detect significant differences in the SF-36 scales. Only females were included in the analysis, which thereby bypassed differential item bias on the SF-36 subscales (Bjorner). The score on an SF-36 item will partly depend on the person’s evaluation of his or her health and partly on the formulation of the questionnaire item, and partly on factors that are not related to health evaluation and therefore give rise to measurement error (120). No stress scale was included in the questionnaire even though the intervention included stress management.

Information on dropout from the HBCE program was based on the schools’ records.

### **Measurement limitations**

Unfortunately due to the study design, it was not possible to register subject participation in the intervention lessons, and therefore it is likely that several or even many study participants allocated to the intervention group had a very low adherence to the different dimensions of the intervention. We do know that although participation in the intervention program was mandatory, some of the students did not show up. Another limitation of this study was that we did not have access to information on the NA students' own leaving reasons.

A manual investigation of a possible migration across groups of individuals into the intervention and control groups was performed. No students were identified migrating into the intervention group. In the control group a group of 20 students migrated into the group, but they were excluded from the analyses because their program diverged from that of the rest of the control group.

### **Strengths of the study**

The strength of the study was that it was a cluster randomized controlled study with a large study population, and a response rate of 65% at follow-up. A randomised study design is preferable to non-random allocation. Non-random allocation increases the probability that unmeasured characteristics that may influence the outcomes are not distributed randomly among comparison groups, introducing a systematic bias that could either exaggerate or reduce true intervention effects. The relatively high participation rate at follow-up is considered to have a positive influence on the internal validity of the study.

The intervention effect was analyzed according to the intention to treat principle regardless of whether the intervention students participated or not. The non-responder analysis showed that non-response was neither associated with sickness absence, LBP nor intervention status. Since the estimated effect differences at follow-up were adjusted for the baseline levels of the covariates, taking into account that these baseline values of the variables to some degree varied between responders and non-responders at follow-up, this was unlikely to bias the result.

## **15. Overall conclusions**

The intervention program on stress management, physical training and patient transfer technique among nurse assistant students in health and social care education (HBCE) promoted a significant reduction of sickness absence among NA students, but failed to prevent LBP.

Furthermore, no significant deterioration was observed in the intervention group regarding general health perception (GH), energy/fatigue (VT) and mental health (MH), whereas in the control group, these measurements were shown to decline. The intervention program did not prevent dropout from HBSE. The female NA students with a history of LBP had an increased risk of dropout when an increasing number of risk factors were present: a history of exposure to heavy physical workloads, a low mental health score and not passing a back extension endurance test.

However, the NA students with health awareness, without LBP and with good self-rated health also had most benefit from the intervention program on sickness absence.

### **Implications for future research and practice**

The multidisciplinary intervention program on LBP and sickness absence indicates that reductions in sickness absence and improved general health among NA students are possible.

This study is the first intervention study to target NA students while they are attending their health and social care education as well as the first intervention study combining physical training, patient transfer techniques and stress management in an integrated intervention approach.

The reduction in sickness absence and stabilised scores on general health perception, mental health and vitality in the intervention group without relation to LBP, indicates that the predominant effect is explained by underlying psychological mechanisms that can be attributed to the stress handling part of the intervention, rather than the physical training part, comprising physical training and patient transfer techniques. This is supported by the fact that the physical tests failed to show an effect.

Further, it can be speculated that the mechanism involved in the intervention effect is mediated through general health perception, vitality and mental health, which are important factors when aiming to decrease sickness absence.

To disclose the interplay between factors mediating participation and adherence in intervention programs aiming at preventing sickness absence, qualitative studies with strategic sampling of subgroups with e.g. high/low motivation and high/low scores on general health, mental health and vitality would be appropriate.

Sickness absence in this study seemed to be related to coping strategies directed toward dealing with adverse situations in school or private life, and the stress management approach seemed to be an efficient prevention strategy.

The identified subgroups characterized by health awareness, good health perception and without LBP have, despite apparent good health functioning, a high sickness absence rate, which the intervention succeeded in reducing. The results showed that sickness absence rates among future nurse assistants are high during their education, and that it is possible to reduce sickness absence rates among the more advantaged NA students.

Regarding the prevention of LBP, the literature on physical training is not convincing and this was supported by the findings of the study. Physical training, however, has many other beneficial health effects e.g. prevention of obesity, diabetes and heart disease which are also important for the NA students. Patient transfer instruction alone is not efficient in the prevention of LBP and the results on combined interventions show diverging results. Future LBP prevention programs should focus on modifying attitudes and response to symptoms of LBP, and in addition include physical training programs with the aim of improving physical fitness in general.

The subgroups with good health functioning in this study had more benefit of the intervention program. Other studies including subgroup analyses have also shown that often it is the most advantaged that benefit from these programs, and in this respect the NA students are not diverging from these populations.

Future studies should focus on prevention of dropout from the HSCE program and be targeted at individual psychosocial factors. Prevention of dropout should not be focused on the prevention of LBP, but students with self-reported LBP symptoms should receive instruction on how to manage the problem, for the purpose of modifying attitude and response to pain symptoms.

Additionally, qualitative studies on how the participants perceive and respond to the intervention program given in randomised trials may be valuable in planning and shaping future interventions.

To increase participation in the physical training and the intervention lessons in general, it is important to develop pedagogical tools and strategies to reach and motivate those who are not willing to participate. When implementing intervention programs it is important to obtain precise information on participation and adherence in order to obtain more details about the effectiveness of the intervention.

The HSCE should consider introducing some of the elements of this study in the NA student curriculum, since the full program is very time-consuming and comprehensive.

When researchers implement intervention programs they should have the experience from this study in mind - are the intended target groups of the intervention also those who benefit from the program? We have to consider that the most vulnerable groups in our societies may not always be reached by group-based interventions. Perhaps these groups need a more individually tailored approach, focusing on the specific barriers that inhibit a change in the individual's health behaviour. It is important to further investigate differential intervention effects among subgroups to obtain more knowledge on which subgroups are not reached and develop prevention programs and motivation strategies aiming at reaching these disadvantaged groups.

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# Paper I

# Factors predicting dropout in student nursing assistants

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<b>Background</b>	The dropout rate among student nursing assistants (NAs) in Danish health and social care education is high at >20%.
<b>Aims</b>	To explore if recent low back pain (LBP) history is a predictor of dropout among NA students, taking into account conventional risk factors for LBP, general health and physical fitness.
<b>Methods</b>	Prospective study with 14-month follow-up (the duration of the education) in two schools of health and social care in the Region of Copenhagen, Denmark. Participants completed a comprehensive questionnaire, and their physical fitness (balance, back extension endurance, back flexion endurance and sagittal flexibility) was assessed at baseline. Dropout was defined as failure to complete NA education.
<b>Results</b>	A total of 790 subjects, 87% of those invited, completed the questionnaire; 612 subjects also completed the physical tests and were included in the present study and 500 (83%) were women. Recent LBP was not an independent predictor of school dropout. However, only among women who had LBP were other factors (a history of previous exposure to heavy physical workload, a low mental health score and failure to pass the back extension endurance test) associated with risk of dropout, OR (95% CI) = 2.5 (1.2-5.3). Among men, only low height was significantly associated with dropout risk.
<b>Conclusions</b>	A recent LBP history was not an independent single predictor of dropout from NA education but was a risk factor in combination with other factors.
<b>Key words</b>	Low back pain; nursing assistants; physical fitness.

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## Introduction

The dropout rate among student nursing assistants (NAs) in Danish health and social care education (HSCE) is high and has increased from 14% in 1993 to 24% in 2003 [1]. A corresponding dropout rate, 15-20%, has been reported among student nurses in the UK [2]. Danish reports have mainly focused on reasons for dropout related to the organization of the education itself and not on the individual factors related to health, lifestyle and physical fitness [1].

NA students and student nurses are frequently exposed to a high physical workload encompassing frequent bending or twisting of the trunk and heavy lifting, all established risk factors for low back pain (LBP) [3,4].

Thus, in a 7.5-year follow-up study of students entering nursing school, the incidence of LBP increased sharply during and after nursing school attendance [5].

Physical strength and endurance (physical fitness) are associated with a lower risk of LBP [6-8], while a high body mass index (BMI), and particularly obesity, has been implicated as a risk factor for LBP [9].

Psychosocial factors, especially those related to distress or a depressed mood, have been implicated in the transition from acute to chronic LBP [10]. In adults, patterns of the relationship between ethnicity and pain have begun to emerge. In a study from the UK, subjects of South Asian origin, when compared to non-South Asian subjects, had an increased risk of reporting disabling LBP [11].

Whether LBP or its covariates are independent risk factors for dropout in NA students is unknown. The aim of the present study was to identify dropout risk factors among students including recent LBP history and potential risk factors for LBP to test the hypothesis that recent LBP is a predictor of dropout among NA students. In addition, we analysed whether risk factors for dropout depend on gender and whether NA students have a higher LBP prevalence than the general population.

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## Methods

The study design was that of a prospective study with 14 months of follow-up (the duration of NA education). The study was conducted in 2004–05. All participants gave written informed consent. Ethical approval was granted by Copenhagen Research Ethics Committee.

All participants completed a questionnaire and participated in a performance-based test session in the first week of NA education. The questionnaire was based on one developed by The National Research Centre for the Work Environment, Denmark [12].

Questions concerning LBP were taken from the Standardized Nordic Musculoskeletal Questionnaire [13,14]. LBP was defined as tiredness, discomfort or pain in the low back region with or without symptoms radiating to one or both legs during the previous 12 months (primary outcome) or during the subject's lifetime (secondary outcome) [15].

A self-reported history of previous exposure to heavy physical work was considered relevant if the subject reported having had a physically demanding job for at least 6 months. Occupations considered physically demanding were homecare worker, orderly (hospital attendant having general, non-medical duties), removal worker, warehouse worker, metalworker, slaughterhouse worker and fisherman.

Current smoking and leisure-time physical activity (LTPA) [16] were included as lifestyle factors. The participants classified themselves as belonging to one of four categories of LTPA, from definitely sedentary to very active, i.e. performing vigorous activity for at least 4 h/week. We included variables on age, gender, years of completed schooling and country of birth. Years of completed schooling was included as a marker of social class and participants were divided into two groups, those having completed  $\leq 9$  years of schooling or  $> 9$  years. The mandatory minimum duration of education in Denmark is 9 years, with children commencing school when they are 6–7 years old.

Psychosocial concepts were assessed with Setterlind's modified nine-item sense of coherence scale (SOC) [17,18] and Bandura's scale of self-efficacy (SE) [19,20]. Evaluation of health status was based on SF-36 general health (GH) perception, vitality (VT) and mental health (MH) scales [21,22].

To assess test–retest reliability of the questionnaire, Pearson's product–moment correlation and Kendall's rank-order correlation coefficient were used in a pilot study including 12 NA students. The results showed a high test–retest reliability with Pearson's correlation coefficients  $\sim 0.80$  (range 0.58–0.98) for questions answered with a 14-day interval.

In this study, we measured the following fitness markers: balance, flexibility of the spine, back extension and back flexion endurance. To do so, we conducted four

different physical fitness tests during a 90-min test session. The isometric endurance of the back muscles was measured using a modified version of the Sørensen test [23]. The subjects were placed on their stomach with their navel over the edge of a padded sloping board, which was 70 cm in length and 15 cm high at the raised end. The subject's feet were pressed down to the floor by an assistant. The hip flexion was approximately  $12^\circ$  during the test. To pass the test, the subject should be able to fold the arms across the chest and hold the trunk in a horizontal position for 180 s. The reliability of the test has been reported as good, showing intraclass correlation coefficients (ICCs) of 0.82–0.96 [23,24].

Isometric back flexion endurance was measured using the test described by McGill [25]. The subject was positioned in a sit-up posture, with the back resting against a jig, angled at  $60^\circ$  from the floor. The arms were folded across the chest, and the knees and hips were flexed at  $90^\circ$ . The jig was pulled back 10 cm and to pass the subject is required to hold the isometric posture for 180 s.

Sagittal flexibility, defined as the distance from the fingertips to the floor, was measured by the modified finger-to-floor method [26], in which the subject flexes the spine and hips maximally, without bending the knees while standing without shoes on a 30-cm measuring box. The test reliability was reported as good, ICC = 0.93 [27].

Balance was evaluated by the one-leg standing test, testing the ability to stand on one leg with the eyes open for 60 s. The test reliability has been reported as ICC = 0.76 [28].

Body weight was measured by a certified weighing machine with a hidden display and height was measured by an electronic height measuring unit [29]. BMI was thereby calculated.

A short one-to-one screening interview was performed before the testing to identify any reasons for exclusion. Exclusion criteria were musculoskeletal pain on the test day in the regions of testing, history of severe LBP, receiving treatment for high blood pressure, fever, headache or pregnancy. Information on dropout from NA education was based on the schools' records.

All analyses were performed using the SPSS version 14.0 [30]. Basic analyses were performed on demographic and physical test variables, using the chi-squared test (likelihood ratio), Student's unpaired *t*-test or Mann–Whitney rank-sum test, for categorical and continuous variables, respectively. We used Kendall's tau-b test to disclose a possible trend in the distribution of LBP within quartiles (the lowest, the two intermediaries and the highest) of the different psychosocial variables (GH, MH, VT, SOC and SE).

We computed a simple risk factor index for school dropout by summing up presence or absence of the following risk factors: previous exposure to heavy physical workload, failure to pass the back extension endurance

test and a MH score in the lowest quartile. Logistic regression analysis was used in the final models using stepwise backward elimination of variables and the maximum likelihood ratio method, accepting a priori variables with  $P$ -values  $<0.10$  as obtained in the univariate analyses. Exit criterion for the variables in the logistic regression analysis was a  $P$ -value  $>0.1$ . Odds ratios are presented with 95% confidence limits.

## Results

Of 906 students invited, 790 participated in the study, 413 from the HSCE in the Copenhagen municipality and 377 from the HSCE in the Copenhagen County giving a final questionnaire response rate of 87%. In all, 612 students completed all physical tests and were included in the study. Those who did not complete the questionnaire were on an average younger than those who did, mean age 29 (SD = 9.3) versus 33 (10.6) years, and there were only small differences in the gender distribution. We observed no major differences in non-participation rates between the two HSCE schools.

Overall we found an acceptable level of missing values regarding questionnaire items of 2%, except for values for psychosocial scales which reached 7%. Among subjects born in foreign countries, the proportion of missing values was up to 15% for the psychosocial scales.

Seventy-one percent of subjects were born in Denmark: of the remainder, their origins were European Union, USA, Norway and Iceland (4%)—former Yugoslavia and Eastern Europe (4%), Middle East (6%), Africa (6%), Asia (5%) and others (4%).

Table 1 shows characteristics of subjects with and without 1-year prevalence of LBP according to exposure history, lifestyle and socio-demographic factors. The mean age of the study population was 33 (SD = 10) years and 500 (83%) were women. We found a 12-month prevalence of LBP of 38%. Subjects with LBP were on an average taller compared to those without, 168 (SD = 8) cm versus 166 (8) cm,  $P < 0.01$ , and more often had Danish Nationality, 83 versus 65%,  $P < 0.01$ . Among subjects with LBP during the past year, 42 versus 33%,  $P < 0.05$ , had previously been exposed to heavy physical work. We found no differences in physical activity, smoking, age, gender, education, body weight or BMI between those with and those without LBP. We found similar results for the 12-month prevalence of LBP during the last year in a gender-stratified analysis (results not shown).

As seen in Table 2, subjects with LBP during the past year had significantly lower SF 36 mean scores; perception of GH, 78 versus 82,  $P < 0.01$ ; VT 67 versus 73,  $P < 0.01$  and MH, 77 versus 81,  $P < 0.01$ . Among subjects with LBP, there were significantly more subjects in the lowest quartile, (VT) 35 versus 21% and (MH) 35 versus 22%,  $P < 0.001$ . When the analysis was stratified for gen-

**Table 1.** Lifestyle, exposure history and other parameters in relation to 1-year prevalence of LBP among NA students

	LBP, <i>n</i> (%), 230 (38)	No LBP, <i>n</i> (%), 371 (62)
Previous history of LBP		
Lifetime prevalence of LBP	232 (100) <sup>a</sup>	322 (17)**
Exposure history		
Heavy physical workload <sup>b</sup>	91 (42)	111 (33)*
LTPA		
Inactive	22 (10)	56 (15)
Light physically active 2–4 h a week	115 (51)	154 (43)
Light physically active >4 h a week	69 (31)	110 (31)
Demanding physical activity >4 h a week	18 (8)	38 (11)
Other characteristics		
Females	196 (85)	304 (82)
Males	34 (15)	67 (18)
Country of birth, Denmark	186 (83)	236 (65)**
Education <9 years of schooling	45 (20)	89 (25)
Smoking	124 (55)	170 (46)
	Mean (SD)	Mean (SD)
Age	33 (10)	33 (10)
Body weight (kg)	71 (14)	69 (15)
Height (cm)	168 (8)	166 (8)**
BMI (kg/m <sup>2</sup> )	25.2 (5)	24.9 (5)

<sup>a</sup>By definition.

<sup>b</sup>Previous history of exposure to heavy physical workload for at least 6 months.

\* $P \leq 0.05$ , \*\* $P \leq 0.01$ .

der, a similar pattern was found for women, while there were no significant differences between subjects with and without LBP among men (results not shown).

As seen in Table 3, subjects with LBP had a lower flexibility of their spines compared to those without LBP,  $-0.7$  (10) cm versus  $-3.0$  (9) cm,  $P < 0.01$ . They also had a lower proportion passing the isometric back extension endurance test, 50 versus 59%,  $P < 0.05$ , and a lower proportion who passed the isometric back flexion endurance test, 40 versus 49%,  $P < 0.05$ . We found similar results for women only (results not shown).

The overall dropout rate from NA education was 29%. Overall, however, there was no difference in the 1-year prevalence of LBP between NA students who dropped out the HSCE and those who completed the programme.

The following results applied only to women, who as mentioned constituted 83% of the study population. Women who dropped out more often had a history of heavy physical workload, 44 versus 33%,  $P < 0.05$ . They also had a lower proportion passing the back extension endurance test, 47 versus 60%,  $P < 0.01$ , and a lower proportion passing the balance test, 79 versus 87%,  $P < 0.05$ .

**Table 2.** Psychosocial factors in relation to the 1-year prevalence of LBP

Psychosocial factors	LBP, <i>n</i> (%), 230 (38)	No LBP, <i>n</i> (%), 371 (62)
<b>GH<sup>a</sup></b>		
Lowest quartile	81 (37)	86 (24)
Intermediary quartiles	106 (48)	184 (52)
Highest quartile	32 (15)	82 (23)
Mean (SD)	78 (15)	82 (15)**
<b>Vitality<sup>a</sup></b>		
Lowest quartile	77 (35)	72 (21)
Intermediary quartiles	102 (46)	180 (51)***
Highest quartile	42 (19)	99 (28)
Mean (SD)	67 (18)	73 (15)**
<b>MH<sup>a</sup></b>		
Lowest quartile	77 (35)	77 (22)
Intermediary quartiles	109 (50)	158 (45)***
Highest quartile	33 (15)	113 (33)
Mean (SD)	77 (15)	81 (14)**
<b>SE<sup>b</sup></b>		
Lowest quartile	60 (28)	79 (23)
Intermediary quartiles	113 (52)	178 (52)
Highest quartile	42 (20)	83 (25)
Mean (SD)	30 (5)	31 (5)
<b>Sense of coherence<sup>c</sup></b>		
Lowest quartile	39 (18)	101 (29)
Intermediary quartiles	118 (54)	144 (42)**
Highest quartile	61 (28)	100 (29)
Mean (SD)	38 (4)	37 (5)*

Student's *t*-test and Kendall's tau-b test for trend.

<sup>a</sup>Range 0–100.

<sup>b</sup>Range 0–40.

<sup>c</sup>Range 0–45.

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

Women who dropped out had a lower mean score of MH, 76 (16) versus 81 (13), *P* < 0.001. Table 4 shows which covariates were significantly associated with dropout, controlling in the analysis for the three confounders identified in Table 1: age, height and years of schooling. A recent LBP history was not an independent single predictor of dropout. We found an increased risk of dropout among women with previous exposure to heavy physical workload, OR (95% CI) = 1.6 (1.1–2.4). The association between dropout and passing the back extension endurance test was OR (95% CI) = 0.6 (0.4–0.98). A MH score >72 was found to be associated with a lower risk of school dropout, OR (95% CI) = 0.52 (0.31–0.93), *P* < 0.05. Factors excluded from the model were one-year prevalence of LBP, age, height, <9 years of completed schooling, flexibility below floor level, SE and VT. When we excluded LBP from the model, we found an association of heavy physical workload and dropout, OR (95% CI) = 1.6 (1.0–2.5), and a MH score >72, OR (95% CI) = 0.4 (0.3–0.7).

Among men, those who dropped out had a lower height, 175.4 (SD = 7.3) cm versus 178.8 (7.0) cm,

*P* < 0.05. No other risk factors for dropout among men could be identified.

We estimated the population-attributable risk (PAR) of a low MH score. Assuming that all participants had a MH score above the lowest quartile, theoretically, as a point estimate 20% of the dropouts would not have occurred. Corresponding estimates of PAR for heavy physical workload and insufficient back extension endurance were 16 and 22%, respectively.

Female NA students with LBP had an increasing risk of discontinuing their studies when an increasing number of the other risk factors were present. When two or more of the above mentioned risk factors were present, recent LBP was significantly associated with dropout, OR (95% CI) = 2.5 (1.2–5.3).

With no non-LBP risk factors present, the dropout rate was 19% while with either one of the non-LBP risk factor present, it was 25%. With two or three risk factors present, the dropout risk was 39%. We included the 1-year prevalence of LBP and the risk factor index according to dropout in a logistic regression model and found a significant interaction OR (95% CI) = 1.32 (1.02–1.72).

## Discussion

A recent LBP history was not an independent risk factor for study dropout among female NA students. However, among female NA students with a recent history of LBP, other factors were predictive of study dropout, namely a previous history of heavy physical workload, failure to pass a back extension endurance test and a low MH score.

The association between heavy physical workload and LBP is well-established in the literature [3,4]. A lower proportion of female NA students with LBP passed the back extension endurance test. This is in accordance with other studies where low back extension endurance, measured by the Sørensen method, is associated with an increased risk of LBP [8,28]. However, Hamberg-van Reenen *et al.* [31] found no association with low back extension endurance and LBP. In relation to MH, women with LBP had lower SF-36 scores.

To our knowledge, no previous studies on NA students have addressed the dropout issue, taking individual health-related factors into account. Previous studies have focused on exit interviews with some methodological problems such as recall bias. Respondents may post-rationalize and thus tend to attach more weight to study factors than individual factors. No previous studies have compared characteristics of students who drop out and those who do not using a prospective design [3].

NA students did not have a higher 12-month prevalence of LBP, when commencing their studies, compared to the same age range in the general Danish population, with a 12-month prevalence of 36% [15].

The strength of our study was that dropout was analysed in a prospective study design. We also had a large

**Table 3.** Results of physical fitness tests in relation to the 1-year prevalence of LBP among NA students

	LBP, <i>n</i> (%), 230 (38)	No LBP, <i>n</i> (%), 371 (62)
Performance-based physical fitness		
Balance (% passed 60 s)	188 (82)	319 (86)
Isometric back extension endurance (% passed 180 s)	114 (50)	217 (59)*
Isometric back flexion endurance (% passed 180 s)	93 (40)	182 (49)*
Flexibility $\geq 0$ cm	94 (41)	125 (34)
Mean (SD) (centimetres below floor level)	-0.7 (10)	-3.0 (9)**
Median (centimetres below floor level)	-2	-4

Flexibility was measured as finger-to-floor distance (cm). Balance, isometric back extension endurance and isometric back flexion endurance are presented as the proportion of subjects passing the tests. Chi-square likelihood ratio test, Student's *t*-test and Mann-Whitney test were used when appropriate.

\* $P < 0.05$ , \*\* $P < 0.01$ .

**Table 4.** Covariates significantly associated with dropout among NA students after adjustment in a logistic regression model

	Women <sup>a</sup> , ( <i>n</i> = 429), OR (CI)	<i>P</i>	Men <sup>b</sup> , ( <i>n</i> = 101), OR (CI)	<i>P</i>
Predictor				
Heavy physical workload <sup>c</sup>	1.6 (1.1–2.4)	*		
Isometric back extension endurance (% passed 60 sec)	0.6 (0.4–0.98)	*		
MH <sup>d</sup>				
Lowest quartile ( $\geq 16$ –72)	1 (reference)			
Intermediary quartiles (>72–88)	0.52 (0.31–0.87)	**		
Highest quartile (>88–100)	0.57 (0.35–0.93)	*		
Height (cm)	–		0.94 (0.80–0.90)	*

Variables are presented according to statistical strength of association with dropout after adjustment. Odds ratios for dropout with 95% confidence limits are presented for variables in the adjusted models ( $P < 0.10$ ).

<sup>a</sup>Excluded in the model, 1-year prevalence of LBP, age, height (cm),  $\leq 9$  years of schooling, flexibility (centimetres below floor level), SE and VT in low, intermediary and high quartiles.

<sup>b</sup>Excluded in the model, 1-year prevalence of LBP and age.

<sup>c</sup>Previous history of exposure to heavy physical workload for at least 6 months.

<sup>d</sup>Range (0–100).

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

study population with a response rate of 77%. Furthermore, physical test measures and GH status were assessed in an appropriate way.

However, there are some limitations in this study. We did not have access to information about the NA students own leaving reasons. Non-responders were on an average younger compared to responders, but we found no associations between age and LBP in this study, and therefore this difference between the groups is unlikely to explain our results.

Although the prevalence of LBP in some studies increases with age [32], the dose–response relationship between age and LBP is not linear, suggesting that multiple factors are involved [11]. We had no information about household income among the NA students, and therefore used their education level as a proxy for socio-economic status.

Physical workload was based on self-reports of type of occupation and its duration. This question was unfortunately not validated in terms of different physical workload levels since the question used did not measure this.

Measurement errors or imprecision maybe relevant for both exposure and effect variables. In this study, it is unlikely that recall bias may have influenced the reporting of the 1-year prevalence of LBP since the time interval is relatively short.

With the aim of minimizing potential bias in the collection of physical test data, we used five experienced test leaders. The test leaders had no information on the subjects regarding current smoking, LTPA level and history of heavy physical work before the testing. Subjects were kept unaware of the specific hypothesis under investigation.

To ascertain that the associations between exposure and effect were not simply the result of occupational

and coping-related factors, being proxies for some underlying risk factors, major potentially confounding factors known from the literature were included in the models.

Our study indicates that some individual factors may influence NA students' dropout rate, suggesting that intervention measures should be targeted at high-risk groups. For further investigation, it would be reasonable to focus on physical training, working technique and stress handling when considering an integrated intervention programme since single interventions hitherto have shown limited evidence of an effect [33].

We therefore conclude that recent LBP history is not an independent risk factor for study dropout among female NA students. However, only among female NA students with a recent history of LBP were other factors predictive of study dropout, specifically a previous history of heavy physical work, poor performance in a back extension endurance test and a low MH score.

### Key points

- Recent LBP was not an independent risk factor for dropout from the health and social care school.
- In female NA students with a recent history of LBP, other factors (a previous history of heavy physical work, poor performance in a back extension endurance test and a low MH score) were predictive of study dropout.
- Further investigation of interventions to reduce dropout rates should focus on physical training, working technique and stress handling.

### Funding

The Working Environment Research Fund (The Danish Employment Ministry).

### Conflicts of interest

None declared.

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## Paper II



# Multidimensional intervention and sickness absence in assistant nursing students

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<b>Background</b>	When handling patients, nursing assistant (NA) students and nurse students are frequently exposed to risk factors for low back pain (LBP) including sudden loads and twisting and bending of the spine. Furthermore, LBP is a major cause of sickness absence.
<b>Aims</b>	To ascertain if a multidimensional prevention programme combining physical training, patient transfer technique and stress management prevents sickness absence and LBP in NA students.
<b>Methods</b>	The study was a 14-month cluster randomized controlled study. The participants were NA students from 37 randomly selected classes located at two schools of health and social care in Copenhagen, Denmark. The participants completed a comprehensive questionnaire regarding sickness absence, LBP and psychosocial factors on commencement and after completion of the study.
<b>Results</b>	Of 766 female NA students, 668 (87%) completed the baseline questionnaire. Sickness absence during the study period increased in both groups but the increase was significantly lower in the intervention group than the control group, mean (standard deviation) number of days 12 (20) versus 18 (34), $P < 0.05$ . The intervention group reported no change in the mean level of general health perception, energy/fatigue or psychological well-being at follow-up, while the control group reported a decline on those scales. There were no significant differences in the prevalence of LBP at follow-up between the intervention and control group.
<b>Conclusions</b>	Compared to the control group, the intervention group had significantly less sickness absence. The intervention had no preventive effect on LBP prevalence.
<b>Key words</b>	Cluster randomized trial; low back pain; prevention programme; sickness absence.

## Introduction

Low back pain (LBP) is a major cause of sickness absence [1–3]. The findings from a 7.5-year follow-up study of students entering nursing school showed that the incidence of LBP increased sharply during and after nursing school attendance [4]. In our previous study in nursing assistant (NA) students, we found a 1-year prevalence of LBP of 38% [5]. When they are handling patients, NA students and nurse students are frequently exposed

to risk factors for LBP including exposure to sudden loads and twisting and bending of the spine [6,7]. In the health care sector in Denmark, great efforts have been made to control these manual handling risks with adequate staffing levels, supervision and training, in addition to investments in manual handling technologies [8]. Sickness absence is not simply an indicator of ill health but may also be a coping strategy used by the student to handle reduced work ability caused by illness, adverse situations in their training or difficulties related to private life [9].

Unidimensional intervention programmes have had little or no effect with respect to preventing LBP among NAs [10]. Alexandre *et al.* [11] examined manual handling and exercise intervention and found a reduction in LBP frequency and intensity, while Linton *et al.* [12] combined manual handling, exercise and lifestyle management and risk assessment and found a reducing effect on LBP intensity. Sudden, unexpected, loads can lead to high compression forces on the lumbar spine and may increase the risk of LBP and injuries [6]. Physical training with the specific purpose of improving the response to

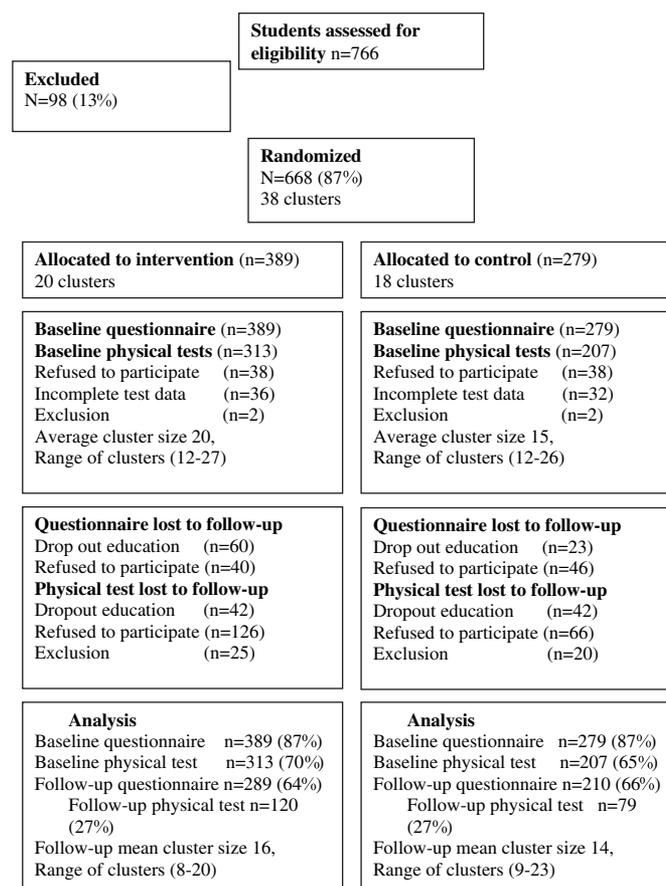
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**Figure 1.** Flow diagram based on numbers of female NA students.

sudden loading has been shown to reduce the reaction time in the low back [6,13].

Moving and handling patients may include exposures to sudden as well as more prolonged loads on the spine. Schibye *et al.* [14] implemented a systematic patient transfer technique resulting in reduced lumbar compression forces at L4–L5.

The stress-coping model related to LBP suggests that stress could have a negative impact on LBP status, either indirectly, through the negative response it produces which can cause biological or behavioural changes, or through biological or behavioural changes that, in themselves, may have a negative influence on the emotional response [15].

In this study, we aimed to evaluate the effectiveness of a multidimensional prevention programme for sickness absence and LBP among NA students.

## Methods

The study was a cluster randomized prospective study with 14 months of follow-up (the duration of the course). The study population comprised 766 female NA students from two schools of health and social care in Copenhagen, Denmark. In all, 668 NA students from 38 classes partic-

ipated in the study. The inclusion criterion was that the student was assigned to one of the allocated classes. Students were randomly allocated to the control or intervention group, resulting in 389 students being assigned to the intervention group (20 clusters) and 279 students to the control group (18 clusters). The study was single blinded. Teaching teams either taught the intervention classes or the control classes to avoid bias. Data were collected in two sessions: in the first week of the semester (baseline) and in the week before the last exam (follow-up). At baseline, all participants completed a questionnaire and were invited to participate in a performance-based test session. All participants gave written informed consent. Ethical approval was granted by the Copenhagen Research Ethics Committee.

The LBP prevention programme consisted of an integrated approach of three preventive measures; physical training (48 h), patient transfer technique education (20 h) and stress management with personal development (22 h). Only the intervention group received the programme. Each physical training session started with 15 min of warm-up with exercises that enhanced back muscle extension endurance and back muscle flexion endurance. This was followed by 40 min of exercise focusing on expected and unexpected trunk loading and balance. The patient transfer technique programme consisted of both theoretical education and practical exercises [16]. The stress management programme was designed to build up the self-confidence of the NA students and to increase their coping capacity and included training on coping strategies and cognitive psychology. The sessions comprised theoretical exercises and group discussions.

Sickness absence was self-reported. The question was phrased ‘how many days during the last 12 months have you been absent due to your own sickness?’ [17].

Questions concerning LBP were taken from the Standardised Nordic Musculoskeletal Questionnaire [18,19]. LBP was defined as tiredness, discomfort or pain in the low back region with or without radiating symptoms to one or both legs [20] during the previous 12 months, referring to at least one episode lasting at least 1 day.

The item on health care use was phrased ‘Because of LBP in the last 12 months have you’ (i) stayed home, (ii) been unable to participate in sports or other leisure time activities, (iii) contacted a physiotherapist, (iv) contacted a physician (v) contacted a chiropractor or (vi) done something else? [17]. There were multiple answer options but in the analysis we focused on whether the subjects had contacted a physician or not.

An exposure history of heavy physical workload was defined as having had a physically demanding job for at least 6 months. Occupations considered physically demanding were home care worker, orderly (hospital attendant having non-medical duties), removal worker, warehouse worker, metalworker, slaughterhouse worker and fisherman.

**Table 1.** Baseline characteristics of the study population

	Intervention 389 (58%) Mean (standard deviation)	Control 279 (42%) Mean (standard deviation)
Sickness absence during the last 14 months (days)	6 (13)	6 (21)
Psychosocial factors (SF-36 subscales)		
GH <sup>a</sup>	79 (16)	79 (15)
Vitality <sup>a</sup>	69 (17)	70 (16)
MH <sup>a</sup>	77 (16)	81 (13)*
SE <sup>b</sup>	30 (5)	30 (5)
Age	32 (10)	33 (11)
BMI	26 (5)	25 (5)
Previous history of LBP <i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
12 months prevalence of LBP	148 (39)	119 (44)
Self-rated health awareness, high	377 (98)	265 (97)
Take care of health	279 (98) <sup>c</sup>	204 (98) <sup>c</sup>
Health care use <sup>d</sup>	61 (36)	37 (27)
Exposure history		
Heavy physical workload <sup>e</sup>	135 (36)	88 (34)
LTPA		
Light physically active >4 h a week	137 (36)	102 (38)
Performance-based physical fitness		
Isometric back extension endurance (% passed 180 s)	175 (56)	114 (55)
Balance (% passed 60 s)	286 (82)	200 (86)
Other characteristics		
Satisfaction with the education	377 (98)	265 (97)
Country of birth, Denmark	280 (73)	197 (73)
Education, <9 years of schooling	94 (25)	58 (21)
Smoking	192 (49)	132 (48)

Chi-square test: likelihood ratio and Students *t*-test was used when appropriate. \* $P < 0.05$ . BMI, body mass index.

<sup>a</sup>Range (0–100).

<sup>b</sup>Range (0–40).

<sup>c</sup>The number of cases in each analysis varies due to different levels of missing on the different questionnaire items.

<sup>d</sup>Consulted a physician because of LBP.

<sup>e</sup>History of exposure to heavy physical workload >6 months.

Current smoking habits [21] and leisure time physical activity (LTPA) [22] were included as lifestyle factors.

General health (GH), vitality (VT) and mental health (MH) were measured with the SF-36 health perception scales, score range from 0 to 100, with higher scores representing better health [23]. A question with five response options on satisfaction with the education was phrased: ‘How satisfied are you with your education, overall?’

A pilot of the questionnaire showed a high test–retest reliability with person correlation coefficients around 0.8 [5].

Body weight was measured by a certified weighing machine [24] and height was measured by an electronic height measuring unit.

A priori power calculation was conducted. To have an 80% chance of detecting a significant ( $P = 0.05$ , two sided) five point difference between the two groups in the mean SF-36 GH perception scores, with a correlation of 0.6 between repeated measures, 168 (336 in total) in each group were required [23].

Differences in baseline characteristics between the intervention and control group were tested with the chi-square test (likelihood ratio), Mann–Whitney rank sum test or Student’s unpaired *t*-test for categorical and continuous variables, respectively (SPSS version 14.0). The non-responder analysis was tested with the chi-square test (likelihood ratio) and Student’s unpaired *t*-test. The effect of the intervention on outcome measures at follow-up was analysed according to the intention to treat principle, including all subjects regardless of whether or not they actually participated in or adhered to the intervention.

The analysis was conducted with all available respondents at the time of follow-up, using mixed effect models with the intervention as fixed effect, and taking into account random variation between students in the same cluster and between clusters. All mixed effect models were adjusted for cluster and age (SAS, Version 9.1 procedure mixed). The models including continuous variables were also used to calculate the intraclass correlation

**Table 2.** Differences in outcome measures (follow-up baseline) compared with intervention status

	Intervention, <i>n</i> (%), 273 (57) Mean difference	Control, <i>n</i> (%), 207 (43) Mean difference
Δ Sickness absence during the last 14 months (days)	5 (14)	9 (48)*
Psychosocial factors		
Δ GH	-3 (18)	-4 (19)*
Δ Vitality	-2 (16)	-6 (16)**
Δ MH	-3 (18)	-7 (19)***
Δ Health care use <sup>a</sup>	<i>n</i> (%)	<i>n</i> (%)
No consultation/consultation	17 (21)	3 (5)*
No change	55 (67)	54 (82)
Consultation/no consultation	10 (12)	9 (1)
Δ 12 months prevalence of LBP		
No pain/pain	55 (20)	46 (22)
No change	191 (70)	135 (65)
Pain/no pain	27 (10)	27 (13)

Δ Are follow-up minus baseline values. Chi-square test: likelihood ratio and Mann-Whitney rank sum test used when appropriate. \* $P < 0.05$ , \*\* $P < 0.01$ , \*\*\* $P < 0.001$ .

<sup>a</sup>Consulted a physician because of LBP.

coefficient in order to compare the variation between clusters to the total variation. The effect of the intervention on the dichotomous health measures at baseline was analysed with logistic regression models adjusting for age and cluster, while the health measures at follow-up, in addition, were adjusted for the baseline values.

## Results

At baseline, 766 female NA students were invited to participate in the study; 668 (87%) completed the questionnaire (Figure 1). The response rate at follow-up was 65% ( $n = 499$ ). The non-responder analysis of those lost to follow-up showed that non-response was not associated with LBP, sickness absence or intervention status. At baseline, the mean (range) cluster size in the intervention and control group was 20 (12–27) versus 15 (12–26), respectively.

There were no significant differences in the demographic features between the intervention and control group (Table 1).

Table 2 shows the mean differences in outcome measures between baseline and follow-up. We tested whether the distributions of the differences in outcome measures between follow-up and baseline in the intervention and the control group were the same. The increase in sickness absence was significantly higher in the control group compared with the intervention group, mean (standard

deviation) 9 (48) versus 5 (14) days,  $P < 0.05$ . Regarding the SF-36 subscales, we found significantly larger decreases in the control versus the intervention group, GH: -4 (19) versus -3 (18),  $P < 0.05$ ; VT: -6 (16) versus -2 (16),  $P < 0.01$ ; MH: -7 (19) versus -3 (18),  $P < 0.001$ , respectively. The median sickness absence was 10 days in both groups. Sickness absence increased in both groups at follow-up, but this increase was significantly lower in the intervention group, 12 (20) versus 18 (34) days (estimated effect difference 5.92,  $P < 0.05$ ) (Table 3). The intervention group reported no change in their baseline mean level of GH perception (GH), energy/fatigue (VT) or psychological well-being (MH) at follow-up, while the control group reported a decline in these scales. At follow-up, GH in the intervention group was significantly higher compared with the control group, 80 (15) versus 75 (17), respectively, with an estimated effect difference of -3.7,  $P < 0.01$ . VT in the intervention and control group at follow-up was 68 (17) and 63 (18) (estimated effect difference -4.69,  $P < 0.01$ ). MH in the intervention and control group at follow-up was 80 (13) and 74 (17) (estimated effect difference -3.94,  $P < 0.05$ ). In the model, we also included LTPA, smoking, satisfaction with the education, health awareness and self-efficacy, but there were no significant differences between the groups. The intraclass correlation coefficients on sickness absence, GH, VT or MH were close to zero, indicating that the variation within clusters was greater than between clusters. The prevalence of LBP increased in the intervention and the control group at follow-up, 139 (50%) and 110 (53%). At follow-up, the intervention group to a slightly lesser extent had consulted a physician because of LBP, 28 versus 33%, but this difference was not significant.

## Discussion

NA students allocated to the intervention group had a significantly lower sickness absence than those allocated to the control group. With respect to LBP, the 1-year prevalence had increased in the intervention as well as the control group and no difference was observed in the relative increase between the two groups. Furthermore, no significant deterioration was observed in the intervention group regarding GH perception (GH), energy/fatigue (VT) and psychological well-being (MH), whereas, in the control group, scores for all these health measures were significantly lower at follow-up and most pronounced for VT and MH items.

The multidimensional intervention used in the present study resulted in a lower rate of sickness absence and less decline in self-assessed health. Considering the lack of association between allocation to the intervention group and LBP, *per se* a strong risk factor for sickness absence, it can be speculated that these favourable outcomes might

**Table 3.** Outcome measures at baseline and after 14 months of follow-up in the intervention and control group and the estimated effect of the intervention

	Intervention group, <i>n</i> (%), 372 (58) Mean (standard deviation)	Control group, <i>n</i> (%), 266 (42) Mean (standard deviation)	Intraclass coefficient	Estimated effect difference	95% confidence interval
Sickness absence during the last 14 months (days)					
At baseline	5 (12)	4 (8)	0.020	-0.50	-2.3 to 1.3
At follow-up	12 (20)	18 (34)	0.000	5.92*	1.1 to 10.8
GH <sup>a</sup>					
At baseline	79 (16)	79 (15)	0.001	0.11	-2.4 to 2.6
At follow-up	80 (15)	75 (17)	0.004	3.7**	-6.5 to 0.9
Vitality <sup>a</sup>					
At baseline	69 (17)	70 (16)	0.000	0.65	-1.9 to 3.2
At follow-up	68 (17)	63 (18)	0.020	4.69**	-8.0 to 1.4
MH <sup>a</sup>					
At baseline	80 (12)	77 (15)	0.000	3.11**	0.8 to 5.4
At follow-up	81 (13)	74 (17)	0.070	3.94*	-7.7 to 0.2
12 months prevalence of LBP					
	<i>n</i> (%)	<i>n</i> (%)		Odds ratio	
At baseline	281 (39)	273 (44)		0.8	0.6 to 1.1
At follow-up	278 (50)	209 (53)		0.9	0.6 to 1.4
Health care use <sup>b</sup>					
At baseline	169 (37)	137 (28)		0.49	0.2 to 1.1
At follow-up	161 (28)	122 (33)		1.4	0.9 to 2.2

Effect difference was adjusted for age, gender and cluster. *P*-values for the mixed effect model: \**P* < 0.05, \*\**P* < 0.01.

<sup>a</sup>Range (0–100).

<sup>b</sup>Consulted a physician because of LBP.

be attributed to the stress management dimension of the intervention programme. Linton *et al.* [25] investigated 185 patients seeking care for non-specific back or neck pain and found those allocated to a cognitive-behavioural intervention had a significantly lower work absenteeism during a 1-year follow-up than a control group. Also the findings of van der Klink *et al.* [26] support the influence on sickness absence of an intervention programme aimed at behavioural change. Using what they referred to as an activating intervention, they included in a prospective, cluster randomized controlled trial 192 patients on first sickness leave. Subjects were asked to develop problem solving strategies for their stress courses, put these into practice and extend their daily activities to more demanding ones. At 12 months, all patients had returned to work, but sickness absence was shorter in the intervention group than in the control group. Some of the effects noted in the intervention group might be due to the so-called Hawthorne effect. However, our findings of an effect of combined intervention on sickness absence, and the above studies, suggest that behavioural, cognitive, psychosocial intervention may have a profound effect on work absenteeism.

Several studies involving nurses and assistant nurses have investigated the usefulness of preventive measures

against development of back pain and back injuries [10]. Only two of these showed an effect on the intensity of LBP; both studies were characterized by using a prevention programme comprising a combination of manual handling training, i.e. ergonomics and physical exercise. These elements were used in our intervention programme also, yet there was no tendency that this combined intervention prevented LBP in the present study.

The intervention effect was analysed according to the intention to treat principle. Unfortunately, due to the study design, it was not possible to register subject participation in the intervention lessons, and therefore it is likely that several or even many study participants allocated to the intervention group had a low adherence to the different dimensions of the intervention. We do know that, although participation in the intervention programme was mandatory, some of the students did not attend. The experience from the physical training lessons was that, on an average, 30–50% of the NA students in a class participated in the training and it was sometimes hard to motivate them to participate. It is possible that the students' performance of the physical training programme and the patient transfer technique were not adequate. A regular training effort is required to obtain a training effect as measured by the physical

test. Lack of participation in the training programme might be the reason why an effect on back extension endurance was not observed. This may dilute the effect of the intervention, but is not considered a validity problem.

The non-responder analysis showed that non-response was not associated with LBP, sickness absence or intervention status. Since the estimated effect difference (Table 3) was adjusted for the baseline level of sickness absence and LBP this was unlikely to be a problem. At follow-up, the participation rate in the physical tests was low. This might have diluted our results due to selection bias, since a possible difference between the groups was not detected. Furthermore, sickness absence and questionnaire data were based on self-reports, and this may have introduced recall bias. Imprecision in this respect would only have a diluting effect. In the Whitehall II study, women in general reported less sickness absence than that recorded in employer's registers. However, self-reported data on sickness absence and LBP have been found to be valid [27,28].

In conclusion, our study indicates that a reduction in sickness absence and improved GH among NA students is possible. The Health and Social Care Education should consider introducing some of the recommendations from this study in the NA student curriculum, although there may be some economic barriers due to extra costs for additional lessons and more training facilities. Larger studies are also needed to demonstrate if the effect has further implications for the students and society as a whole. Future studies should also focus on the implementation of intervention programmes in order to obtain precise information on participation and adherence.

### Key points

- The combined intervention used in the study resulted in a decrease in sickness absence as well as relative improvements in self-assessed health.
- A multidimensional prevention programme did not prevent an increase in low back pain among assistant nursing students.
- Future studies should focus on the implementation of intervention programmes in order to obtain precise information on participation and adherence.

### Funding

The Danish Working Environment Research Fund; The Danish Ministry of Employment.

### Conflicts of interest

None declared.

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Paper III



**29 September 2009**

**Intervention against low back pain among assistant nursing students  
-Who benefits?**

**Abstract: 216 words**

**Manuscript: 3430 words (max. 3000-5000)**

**Manuscript prepared for Appl Ergonomics**

## **Abstract**

The aim of the study was to investigate if disparities in health had an impact on which subgroups benefited most from a multidimensional intervention on sickness absence. The following subgroups were analyzed: low-high scores on SF-36 scales of general health perception (GH), vitality (VT) or mental health (MH), low back pain (LBP) yes/no, take care of own health yes/no, smokers versus non-smokers and leisure time physical activity more/ less than 4 hours a week. Cluster randomized controlled intervention study among 668 female Danish NA students with 14 months follow-up. The intervention included stress management, physical training and patient transfer techniques.

A logistic regression analysis showed that NA students in the intervention group had a reduced risk of having more than 10 days of sickness absence, OR=0.63 (0.4-0.98).

The control group had an increased risk of more than 10 days of sickness absence OR 95% CI, OR=1.6 (1.04-2.5). An explorative analysis indicated that four subgroups: those who took care of their own health, had a high vitality score, had a high general health score and those without low back pain had the most benefit.

In conclusion the results showed that the intervention reduces sickness absence. Nursing assistant students with good health status, without LBP and those who take care of their own health had the most benefit of the intervention with reduced risk of long-term sickness absence.

## **Background**

We have previously shown that nurse assistant (NA) students allocated to a multidimensional intervention program aiming to reduce low back pain (LBP) have lower rates of sickness absence compared with a control group. (Svensson *et al.* 2009)

The general health perception (GH), energy/fatigue (VT) and psychological wellbeing (MH) scores were higher in the intervention than in the control group after the intervention. In the control group these scores were shown to decline, indicating deteriorating health in the study period. (Svensson *et al.* 2009). The intervention program consisted of three preventive measures: physical training, patient transfer techniques and stress management.

The purpose of the physical training and patient transfer techniques that were part of the intervention was to reduce the risk of developing musculoskeletal disorders, in particular those related to LBP or injury. Musculoskeletal disorders (MSD) are among the most common causes of sickness absence among nurse assistants, with non-specific LBP accounting for roughly half of all sickness absence due to musculoskeletal conditions. (Burdorf and Jansen 2006, FOA 2007, Smedley *et al.* 1995, Wadell 2006).

Poor psychosocial working environment also influence sickness absence. (Nielsen *et al.* 2004) Some of the sickness absence that can be ascribed to the psychosocial work environment is associated with mental health problems, stress, anxiety or depression (Munch-Hansen *et al.* 2009). Sickness absence is not simply an indicator of ill health, it may also be a student's coping strategy to handle reduced work ability caused by illness, adverse situations at school or difficulties related to private life. (Voss *et al.* 2004)

In a review of work health promotion and sickness absence by Kuoppala *et al.* 2008 the results showed that activities involving exercise, lifestyle and ergonomics might be effective in preventing sickness absence, while psychological interventions alone did not seem effective.

Experience from the world of sports indicates that it is possible, by means of targeted psychological interventions, to improve young people's motivation and energy to embark on new tasks. This experience was transferred to the NA students in health and social care education (HSCE). The stress model used in the present study was a five-step stress model, dividing the stress process into 1) situation or event 2) assessment (thoughts) 3) physiological reaction 4) emotional reaction and 5) action. (Jensen **1997**) The stress response according to this model is either active or passive. In the active response the stressful situation will be perceived as a challenge, while in the passive response it will be perceived as a threat.

Helmhout PH *et al.*, suggested that studies including patients with LBP allocated to exercise interventions should use subgroup analysis to identify which patients most likely to benefit. (Helmhout PH *et al.* **2008**) In general, adequate classification of homogeneous subgroups could improve outcomes and reduce the overall costs of interventions. Barriers to identifying or reaching individuals with the highest risk may result in differential intervention effects among subgroups. (Slade *et al.* **2009**) Some studies have shown that adherence to intervention programs among subgroups differ, resulting in different intervention effects. (Medina-Mirapix *et al.* **2009**, Fisher *et al.* **2009**)

In the current analysis we explored which potential subgroups gained most benefit from the multidimensional intervention on sickness absence.

## **Method**

The study design was a cluster randomized prospective intervention study with 14 months of follow-up (the duration of the education), which has been described in detail elsewhere (Svensson *et al.* **2009**). Among the 766 invited female NA students, 668 from 38 classes participated in the study. The inclusion criterion was that the student was assigned to one of the allocated classes.

The teaching teams were separated so that the teams taught either the intervention classes or the control classes, to avoid bias from the teaching staff. It was not possible to blind the NA students receiving the intervention. Data were collected in two sessions; in the first week of the semester (baseline) and in the week before the last exam (follow-up). At baseline and follow-up, all participants completed a questionnaire, and they were invited to participate in a performance based test session. All participants gave written informed consent. Ethical approval was granted by the Copenhagen Research Ethics Committee (case ref. no.: 2003-41-3508).

The health and social care education program (HSCE) alternates between theoretical modules at the school (1/3) and practical training in nursing homes or in the homecare service (2/3). The intervention program consisted of an integrated approach of three preventive measures, combining physical training (48 hours), patient transfer techniques (20 hours) and stress management and personal development (22 hours). All intervention students were offered the same generic intervention. The intervention group also received the program during the training periods. A description of the physical training and patient transfer techniques has been published elsewhere. (Svensson *et al.* **2009**).

The program for stress management and personal development intended to build up the NA students' self-confidence and increase their coping capacity, making them capable of reacting appropriately in situations where they work under pressure and/or feel stressed. The five-step stress model made it possible to structure and implement the training program. (Jensen **1997**) By making the individual more conscious of work requirements (physical, mental, requirements of planning, etc.) it was expected that his or her assessment of the situation would be established (for instance in relation to certain personality features, self-esteem, lifestyle factors or specific work asks).

Next, the individual was made conscious about stress response (somatic, cognitive, perception style, concentration ability, etc.) in order to gain an understanding of the consequent emotional reaction. A description of the individual's behaviour viewed in the light of the mentioned raised consciousness was expected to convey greater understanding of the personal stress cycle, thereby creating a possibility to target the stress abating effort (coping strategies and personal development), and giving the individual a toolkit for experiencing control. The sessions comprised theoretical exercises and group discussions.

Sickness absence was self-reported. The question was phrased "how many days during the last 12 months have you been absent due to your own sickness?" (NRCWE 2007). Questions concerning LBP were taken from the Standardised Nordic Musculoskeletal Questionnaire (Kuorinka *et al.* 1987, Dickinson *et al.* 1992) with LBP being defined as tiredness, discomfort or pain in the low back region with or without radiating symptoms to one or both legs during the previous 12 months, referring to at least one episode lasting at least one day. (Working Group for Danish Institute for Health Technology Assessment 1999). Socio-demographic variables included age, gender, years of completed schooling and country of birth. Standardized measures of smoking habits (Wikman and Ørhede 1998) and leisure time physical activity (Saltin and Grimby 1968) were included.

General health (GH), vitality (VT) and mental health (MH) were measured using the SF-36 health perception scales, score range from 0-100, with higher scores representing better health (Bjørner *et al.* 1997). A five-category question on satisfaction with the education was phrased: "How satisfied are you with your education, overall?"

Body weight was measured by a certified weighing machine (SOEHNLE 2004) and height was measured by an electronic height measuring unit.

A pilot test of the questionnaire showed high test-retest reliability with Pearson correlation coefficients around 0.5.(Svensson 2008)

### **Statistics**

An a priori power calculation was conducted. To have an 80% chance of detecting a significant ( $p=0.05$ , two sided) five point difference between the two groups in the mean SF-36 general health perception scores, with a correlation of 0.6 between repeated measures, 168 (336 in total) in each group were required. (Bjørner *et al.* **1998a**)

We included only the female NA students (83%) in the analysis since there were only few men. Quartile cut points for the SF-36 subscales were chosen from a normal Danish female population, age range 25-34 years, cut points for the lowest quartiles, Low GH  $\leq 77$ , low MH  $\leq 72$  and low VT  $\leq 55$ . (Bjørner *et al.* **1997**)

All statistical analyses were performed using SAS statistical software version 9.1 (SAS institute Inc., Cary, NC, USA). Differences in baseline characteristics between the groups with or without 10 days of sickness absence were analyzed with the chi-square test (likelihood ratio) and students' unpaired t-test for categorical and continuous variables, respectively. Correlations were estimated with Kendall's correlation test (ranks).

The effect of the intervention on outcome measures at follow-up was analyzed according to the intention to treat principle, including all subjects regardless of whether or not they actually received the complete intervention. Logistic regression models were made, using the proc logistic procedure with stepwise backward elimination of variables and the maximum likelihood ratio method, accepting a priori variables with  $P$ -values  $< 0.5$  as obtained in the univariate analyses. The exit criterion for the variables in the logistic regression analysis was a  $P$ -value  $> 0.1$ . Odds ratios are presented with 95% confidence limits.

## Results

Out of 766 female NA students, 668 (87%) completed the baseline questionnaire. The response rate at follow-up was 496 (65%). The non-responder analysis showed that the loss to follow-up was neither associated with sickness absence nor intervention status. Overall, regarding questionnaire items we found acceptable levels of missing values of 2%, except for values on the psychosocial scales (GH, VT, MH) that reached 7%. Among women born in foreign countries the proportion of missing answers was up to 15% on the psychosocial scales. 73 per cent were born in Denmark. The median sickness absence was 10 days in the intervention and the control group.

The distribution of the scores on the SF-36 subscales on GH, VT and MH at baseline is presented in Figure 1. The distribution of the GH, VT and MH scales are bell shaped around the mean value.

The proportion of NA students with a GH score  $\leq 77$  was 45% compared to 25% among females in the same age range (25-44 years) in the general Danish population (results not shown). This indicates that female NA students have a poorer health status when they start the Health and Social Care education program compared to females in the same age range in the general Danish population. NA students scoring low on the MH and the VT scale correspond to findings among females in the general Danish population.

Female NA students with more than 10 days of sickness absence more often had a VT score  $\leq 55$ , 24% versus 12%,  $p=0.005$ . Of the NA students who reported that they took care of their health, 82% versus 92%,  $p=0.01$ , had more than 10 days of sickness absence (Table 1). NA students with more than 10 days of sickness absence, were often smokers, 51% versus 41%,  $p=0.05$ .

Significant correlations were found between the SF-36 variables indicating that they measured related concepts of health (Table 2). An especially high correlation was found between

vitality and MH. The results did not show serious co-linearity between the covariates and therefore, all baseline covariates were included in the analysis.

A logistic regression analysis of predictors of more than 10 days of sickness absence at follow-up is shown in Table 3, the full model showed that NA students in the intervention group had a lower risk of more than 10 days of sickness absence OR (95%CI) = 0.6 (0.4-0.98). Those who did not take care of their own health had an increased risk of having more than 10 days of sickness absence at follow-up, OR (95%CI) = 2.1 (1.1-4.1). However, LBP during the last year, MH and GH were not identified as independent predictors of sickness absence. Interactions between the intervention and vitality and taking care of own health, respectively were not found.

In the reduced model (1) (table 3), the intervention group had a reduced risk of having more than 10 days of sickness absence at follow-up, OR (95%CI) = 0.63 (0.4-0.97). More than 10 days of sickness absence was associated with having a VT score below or equal to 55, OR (95%CI) = 2.1 (1.1-3.7), not taking care of their health, OR (95%CI) = 2.1 (1.03-4.1) and smoking OR (95%CI) = 1.5 (1.1-2.4).

Finally, an explorative analysis was performed using the reduced model (1) on subgroups with sickness absence >10 days a year as outcome. The following subgroups were analyzed: GH  $\leq 77$  or  $\geq 78$ , MH  $\leq 72$  or  $\geq 73$  and VT  $\leq 55$  or  $\geq 56$ , LBP versus no LBP, taking care of own health yes or no, smokers versus non-smokers, light physical activity more or less than 4h a week, age (<30 years or 30+ years) and satisfaction with the education program or not.

The results are not presented in the tables. The subgroup analyses were made separately.

Among women who did take care of their own health, a logistic regression model showed that the intervention group had a significantly decreased risk of more than 10 days of sickness absence, OR (95%CI) = 0.47 (0.3-0.78). Increased risk of more than 10 days of sickness

absence were found among women with a VT score  $\leq 55$ , OR (95%CI) =1.9 (0.9-3.8) and smokers OR (95%CI) =1.7 (1.02-2.7). Likelihood ratio test for the model  $P=0.004$ .

In the group of NA students with a VT score above 56, the intervention group had an decreased risk of >10 days of sickness absence, OR (95%CI) =0.48 (0.28-0.8). Likelihood ratio test for the model  $P=0.002$ .

Among women with a high GH score  $\geq 78$ , the intervention group had a reduced risk of more than 10 days of sickness absence OR (95%CI) =0.44 (0.2-0.8). Likelihood ratio test for the model  $P=0.01$ . In NA students without LBP, the intervention group also had a reduced risk of sickness absence, OR (95% CI) =0.49 (0.3-0.9). Likelihood ratio test for this model  $P=0.003$ . We found no interaction in any of the above mentioned analyses.

## **Discussion**

The analyses showed that some selected subgroups of the NA students were found to benefit more from the LBP intervention program on sickness absence than other subgroups. The subgroups that were shown to benefit most were those who took care of their own health, had a good perception of general health and vitality and those without LBP. We have previously shown that NA students who receive a multidimensional intervention program aimed to reduce LBP have lower rates of sickness absence. However, the intervention failed to show an effect on LBP.

Very little is known about differential intervention effects in health prevention programs. Barriers to identifying or reaching individuals at the highest risk may result in different intervention effects among subgroups. (Slade *et al.* 2009) Another reason could be different adherence to intervention programs among subgroups. (Medina-Mirapix *et al.* 2009, Fisher *et al.* 2009) Recent research on adherence to mammography screening programs, have shown lower participation rates among women with low education, women without contact to primary care

physician and women without dental care. (von Euler-Chelpin *et al.* **2008**) These results indicate a widening in the social inequity in health due to selection and adherence. The subgroup analysis in this study showed, unfortunately, that the intervention contributed to increased inequality in the pattern of sickness absence among NA students, instead of helping the more disadvantaged to improve their coping capacity and health status, enabling more students to be present at school and follow more classes.

The effect of the intervention on sickness absence is in accordance with a review on work health promotion and sickness absence by Kuopalla *et al.* **2008**, where exercise and ergonomics were shown to have a preventive effect on sickness absence among different occupations. Only few studies have investigated the effect of psychosocial interventions in the prevention of sickness absence as we did with some positive results (Linton *et al.* **2005**), van der Klink *et al.* **2003**). In a multidimensional intervention study among health care workers on sickness absence (Tveito and Eriksen **2009**), the authors concluded that there was no intervention effect on sickness absence and subjective health complaints. In the specific case the sample size was small (40 in total), and no statistical significant effect on the SF-36 scales was found.

Other similar studies have indicated that SF-36 scores predict sickness absence. In a study of participants working in the public sector in Sweden, they compared the ability of three different health check-up models to predict sickness absence (Falkenberg *et al.* **2009**). They concluded that self-rated health with one single question (the first item in the GH SF-36 scale) had a quality in predicting sickness absence that was as good as more complicated models including biomarkers. This illustrates that individuals' own perception of health capture more aspects of health than even several lifestyle factors in combination with objective biomarkers of health.

NA students with a high VT score were shown to benefit from the intervention program. The expectation was that students characterized by fatigue (a low vitality score) would have had

relatively higher effect from the intervention. However, this was not the case. As we did not find interaction between vitality and the intervention, it is difficult to determine which mechanisms that were underlying these findings.

The vitality scale is considered to be a subjective measure of general well being. Despite the combinations of items in the scale are intended to capture positive health states (energy) as well as somatic expressions of physical illness (fatigue), the results of this study showed that the VT scale was significantly correlated to the mental health scale, as well as the GH scale.(McHorney *et al.* **1993**) This is in agreement with Persson who evaluated the clinical validity of SF-36 among Swedish women and found the vitality scale to be moderately to substantially correlated with both physically and mental health. However, it was more correlated to the mental dimension compared to a corresponding U.S. study. (Persson *et al.* **1998**)

However, a low mental health score in this study was not associated with high sickness absence, even though a low mental health score was expected to show such an association.

The strength of the study was that we had a cluster randomised controlled study with a large study population with a response rate of 65% at follow-up. The intervention effect was analysed according to the intention to treat principle. Health status was measured by the SF-36 subscales. The Danish version of SF-36 has shown to have adequate internal validity, internal consistency and a factor structure that resembles the U.S. version. (Bjørner *et al.* **1998b**)

The SF-36 subscales provided a good discrimination of general health, vitality and mental health in the population in this study. In addition this study had sufficient statistical power to detect significant differences in the SF-36 subscales. We included only women in the analyses and thereby bypassed the gender differential item bias on the SF-36 subscales. The score on an SF-36 item will depend partly on the person's evaluation of his or her health and partly on the formulation of the questionnaire item. (Bjørner *et al.* **1999**)

A constraint in this study was that, due to the study design, it was not possible to register subject participation in the intervention lessons. However, due to the design with inclusion of students in classes, it was possible for the schools to motivate and remind the students about participation in the intervention. The non-responder analysis showed that non-participation was neither associated with sickness absence nor intervention status.

Data on questionnaire data and sickness absence were based on self-reports and may have introduced recall bias.

In general self-reported data on sickness absence has been found to be valid. (Ferrie *et al* 2005, Baron *et al.* 1996) However, for women self-reported sickness absence has been found to be systematically lower than register records (Ferrie *et al* 2005). Imprecision in this respect would only have a diluting effect on the results.

When researchers implement intervention programs they should have the experience from this study in mind. Are the intended target groups of the intervention also those who benefit the most? We have to consider that the most vulnerable groups in society may not always be reached by group-based interventions. Perhaps these groups need a more individually tailored approach, focusing on the specific barriers that inhibit a change in health behaviour. Future intervention studies may reconsider the conceptualizing of intervention programs and how they should be implemented and executed.

## **Conclusion**

In conclusion the results showed that the intervention reduces sickness absence. Nursing assistant students with good health status, without LBP and those who take care of their own health had the most benefit of the intervention with reduced risk of long-term sickness absence.

Unfortunately, the intervention had no effect on sickness absence in groups that are likely to have higher absence levels namely NA students with LBP and poor self-rated health status. The results showed that the intervention contributed to increasing inequality in the pattern of sickness absence among the NA students, instead of helping the disadvantaged to improve their coping capacity and health status and enabling more students to be present at school.

### **Funding**

The Danish Working Environment Research Fund, The Danish Ministry of Employment, funded the study.

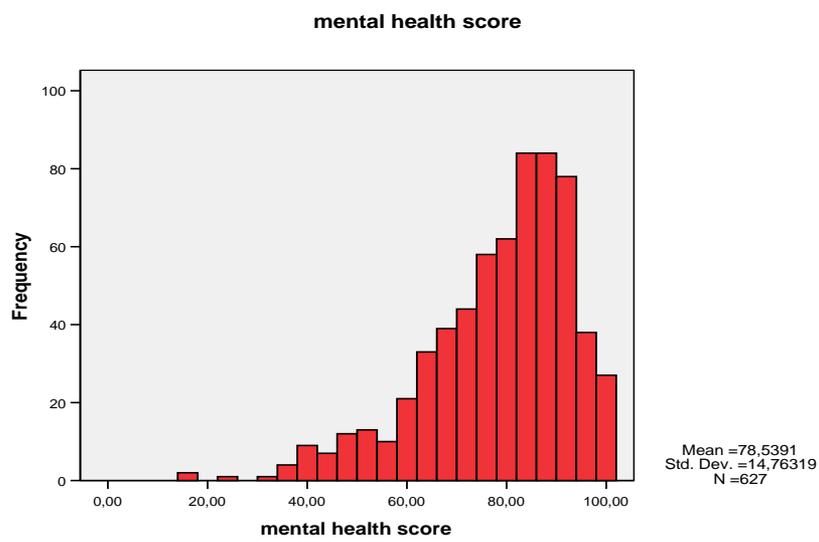
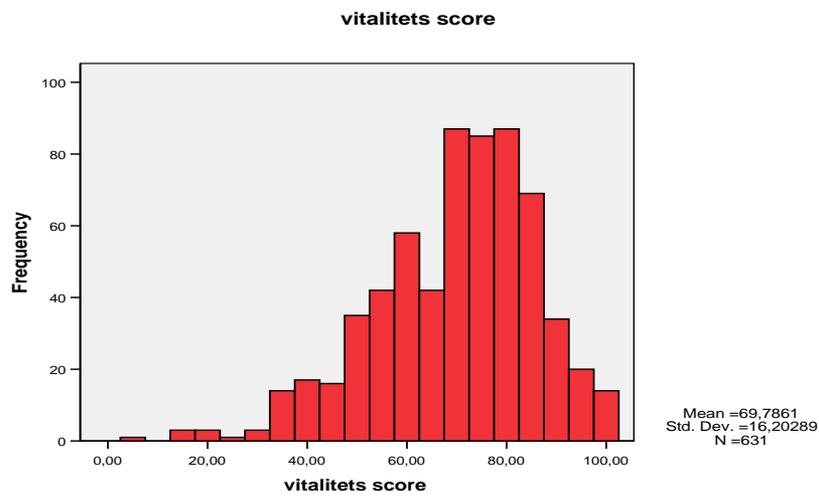
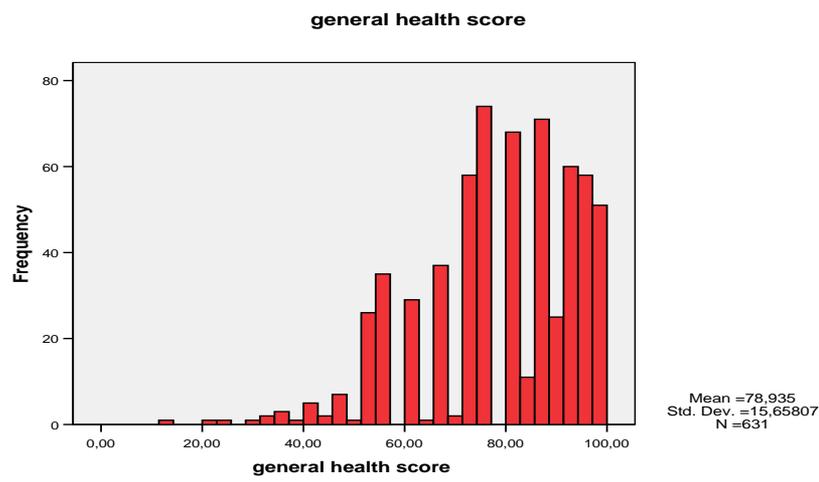


Figure 1. Distribution of baseline SF-36 subscales on general health, vitality and mental health among female NA students.

**Table 1.** Sickness absence at follow-up and frequencies of psychosocial factors, intervention status and lifestyle among female NA students

	Sickness absence <10 days a year 161	Sickness absence >10 days a year 214
Age	Mean (SD) 34 (10)	Mean (SD) 33 (11)
BMI	25 (5)	25 (6)
	<i>n</i> (%)	<i>N</i> (%)
Control	61 (36)	98 (47)*
Intervention	106 (64)	110 (53)
SF 36 subscales		
General health <sup>a)</sup> , ≤77	72 (43)	93 (45)
Vitality <sup>a)</sup> , ≤55	20 (12)	50 (24)**
Mental Health <sup>a)</sup> , ≤72	39 (23)	62 (29)
Take care of health	154 (92)	170 (82)**
12 months prevalence of LBP	65 (39)	94 (45)
Lifestyle factors		
Smoking	68 (41)	106 (51)*
LTPA		
Light physically active <4 h a week	103 (62)	130 (63)
Other characteristics		
Satisfaction with the education program	157 (94)	186 (89)
Country of birth, Denmark	123 (74)	167 (80)
Education, <9 years of schooling	35 (19)	50 (21)

Chi-Square test: likelihood ratio and Students t-test were used when appropriate.

<sup>a)</sup> Range 0-100. \* $P < 0.05$ , \*\* $P < 0.01$ .

Table 2. Correlations matrix on the key variables included in the logistic regression model.

	Age	Take care of health	Satisfaction with the education program	Vitality	Mental health	General Health	Smoking	LBP
Age	1.0							
Take care of health	-0.067	1.0						
Satisfaction with the education program	-0.001	0.044	1.0					
Vitality <sup>a)</sup>	0.127**	-0.187*	0.157**	1.0				
Mental health <sup>a)</sup>	0.105**	0.08	-0.068	0.382**	1.0			
General health <sup>a)</sup>	-0.014	0.026	0.053	0.219*	0.184**	1.0		
Smoking	-0.013	0.129**	0.009	0.000	-0.038	0.015	1.0	
LBP	0.2	-0.129**	0.044	0.09	0.127**	0.147**	0.107**	1.0

Correlation analysis: Kendall's tau b. \*p<0.05, \*\*p<0.01.a) range 0-100.

**Table 3.** Baseline covariates significantly associated with sickness absence more than 10 days/year at follow-up among NA students after adjustments in a logistic regression model.

	Full model (n= 375)	Reduced model (1) (n=375)
	OR (CI)	OR (CI)
Intervention (intervention group)	0.63 (0.4-0.98)*	0.63 (0.4-0.97)*
General health <sup>a)</sup>	0.9 (0.6-1.4)	
Vitality <sup>b)</sup>	1.9 (0.9-3.6)	2.1 (1.2-3.7)*
Mental health <sup>c)</sup>	1.1 (0.6-1.8)	
Do not take care of health	2.1 (1.1-4.4)*	2.4 (1.03-4.1)*
Not satisfied with the education	1.6 (0.7-3.6)	
Smoking	1.5 (0.97-1.0)*	1.5 (1.01-2.4)*
Leisure time physical activity <4 h. a week	0.9 (0.6-1.5)	
LBP 12 months prevalence	1.1 (0.7-1.8)	
Age	0.99 (0.97-1.01)	0.99 (0.97-1.0)
BMI	1.03 (0.98-1.07)	
Country of birth, Denmark	0.8 (0.5-1.4)	
Education, <9 years of schooling	1.1 (0.6-2.1)	
Intervention* Do not take care of health	Ns	
Intervention* Vitality	Ns	

Variables are presented according to statistical strength of association with >10 days of sickness absence after adjustment. Odds Ratios for sickness absence with 95% confidence limits are presented for variables in the adjusted models ( $P<0.1$ ).

<sup>a)</sup> Cut point  $\leq 77$ , <sup>b)</sup> cut point  $\leq 55$  <sup>c)</sup> cut point  $\leq 72$ . \* $P<0.05$ .

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## Appendix



**Appendix 1** Intervention studies on nurses aides/ nurses with the aim of preventing low back pain (LBP).

Author	Methods Randomization	Inclusion criteria, number, sex and age	Duration of intervention, follow-up	Control group	Part. Rate	Outcomes	Results	Comments
<b>Trials of manual handling</b>								
Hartvigsen J. 2005 (1)	NCT	Inclusion criteria: all nurses and nurses aides in four municipalities. N=309 All females, age 44 (21-64) years.	Body mechanics and lifting techniques 1 h. a week for 2 years. Follow-up: 2 years	Three-hour instruction in lifting technique.	Baseline: 92% Follow-up: 83%	Number of days with LBP during the last year	No significant differences on LBP variables.	Intensive weekly education in body mechanics and lifting technique and use of low-tech ergonomic equipment were not superior to a one-time 3hour instruction in lifting technique.
Johnsson C. 2002 (2)	NCT	Inclusion criteria: registered nurses, state enrolled nurses, occupational therapists, physiotherapists in a geriatric ward. Females: n=44 Males: n=7 Age: 36.4 years	Patient handling and moving skills. Group based learning compared to quality circles. Follow-up: 6 months	None	85%	Musculoskeletal problems, perceived physical exertion during transfers 'from bed to chair' Job strain	Improved transfer technique No significant decrease in musculoskeletal problems or job strain.	
Smedley J. 2003 (3)	NCT	Allocation by hospital in two groups. N=1167 nurses 90% female age: four equal age groups,	Intervention: 700 sliding sheets, additional lifting and manual handling equipment. 2-day training	Usual practice	55%	LBP lasting more than 1 day during the last month	No difference in LBP prevalence	The control hospital took steps to improve the manual-training program provided for

Videman T. 1989 (4)	NCT	<30, 30-39, 40-49, ≤50 years.	course in manual handling. 18 and 28 months of follow-up	Usual curriculum	Follow-up 65%	Back pain incidence, severity and injury and disability.	Though back pain was independent of patient-handling skill, those rated as "bad" or "poor" had more back injuries.	nursing staff and extend the use of patient-handling equipment in the wards. This coincided with the program at the intervention Hospital. There was no significant difference when stratifying for intervention/control.
Yassi A. 2001 (5)	RCT	Inclusion: student nurses by year of enrolment into two groups N=308 21.9-23.1 years gender: not mentioned	40-h training in biomechanics and ergonomics over 2.5 years Follow-up: 12 months	Usual practice	Follow-up one year: 75%	Work related LBP, disability and back injuries.	Compared with control group, LBP was reduced in group 2. at 6 months, and in group 1. at 12 months. No change in disability or back injuries	
		Inclusion: 9 Medical, surgical and rehabilitation wards were selected from similarity with respect to type of patients, size of ward, staffing and previous injury rates. (gender & age not mentioned) N=346 nurses and nursing assistants	Intervention: Allocation to 3 groups: 1. sliding and transfer equipment, one lifter, 2. multiple new lifters 3. control Intervention groups perceived intensive training in back care, patient assessment and handling techniques 3-h. Follow-up: 6 months and one year.					

<b>Multidimensional interventions</b>												
Warming S. 2008 (6)	Cluster RCT	Inclusion criteria: All the nursing staff working in the 11 wards. N=337 Age=34.8 years. 90% females	Transfer technique alone or Transfer technique in combination with physical fitness training.  Follow-up: 1-year	Control group following usual routine.	Baseline: 73% Follow-up: 35%	Self-reported LBP, pain level, disability related to LBP and sick leave at 12-months follow-up.	Implementing transfer technique alone or in combination with physical fitness training among hospital staff did not when compared to a control group show any effect on LBP, pain level, and sick leave.	The subgroup receiving the combined fitness training and transfer technique intervention improved on disability.  Weakened by a high withdrawal rate.				
Linton S. 2005 (7)	RCT	Inclusion criteria: Employed, 20-60 years, patients with non-specific LBP or neck pain, <4 months sick leave due to spinal pain during the last year, no physiotherapy the last year. N=185 Age: 48.2 years Gender: 85% females	I: Minimal treatment II: I+ cognitive behavioural group intervention. III: I+II+ preventive physiotherapy focusing on physical exercise.	Control group: Minimal treatment group	Follow-up: 85%	Health care utilization Sickness absenteeism	Adding a specific intervention to minimal treatment reduced future health care utilization and long-term sick leave. Furthermore this reduced the risk of future disability five-fold.	Supports that an early, psychologically oriented interventions produce significant improvements and may reduce the risk of developing chronic problems.				
Alexandre N.M.C. 2001 (8)	RCT	Inclusion criteria: female nursingaides with LBP for at least 6 months working in a	Intervention: Strength and flexibility exercise 1h, 2x /week and manual handling education for 4	Control received a 45 minute class anatomy and of the spine and patient transfer	Participation Rate: 98%	Back pain frequency and intensity.	Reduced LBP frequency (7 days, =0.07).  Reduced LBP intensity (7 days and 2					

			hospital	months during work hours, and a set of exercises to be performed after work hours. Follow-up: 4 months	technique			month).	
Jensen L.D. 2006 (9)	RCT	Included: All home care workers, nurses and nurses aides from three separate eldercare wards. N=234 Females, 44 years	Intervention 6 months I: Transfer technique intervention (TTI) II: Stress management intervention (SMI) Follow-up: 2 years	Lessons of their own choice in matters unrelated to the intervention (e.g. Skincare, or diabetes care).	Baseline 90% Follow-up 79%	LBP intensity during the last three months	No difference in LBP in any of the intervention arms		
Tveito T. 2009 (10)	RCT	Inclusion: Nurses, nurses auxiliaries, some assistants without formal education. N=40 Females, Age: not mentioned	Intervention duration: 9 months. physical exercise 1 hour, 3x a week and information on stress, coping, health and lifestyle and a practical examination of the workplace 15 h. Follow-up 1 year	The controls participated in the pre- and post tests. They were offered the intervention programme after the intervention was finished.	Baseline 65% Follow-up 78%	Main: Sick leave and subjective health complaints. Secondary: Coping, job stress, effort reward imbalance, demands, control, health related quality of life, subjective effects of the intervention	No effect on sick leave or health related quality of life. The intervention group reported fewer neck complaints, Improvements in health, physical fitness, muscle pain, stress management, maintenance of health and work situation.		
Horneij E.J. 2001 (11)	RCT	Inclusion criteria: Swedish speaking, permanently employed, on	1) Individually designed Physical training program 6 months duration: Posture,	Participants were requested to live as usual.	All follow-ups: 60%	Neck, shoulder, back pain. Perceived physical exertion at work and perceived work related psychosocial factors	No significant differences between the three groups. Improvement in LBP in both		

Linton S. 1989 (12)	RCT	<p>duty and working at least 50% of full time, not pregnant and not suffering from current disease that could interfere with the results. Included: n=282 Nursing aides and assistant nurses. Females, 44 years</p>	<p>balance, endurance, functional, stretching and cardiovascular exercises suggested <math>\geq 2</math> x/week. 2) stress reduction: 7 weeks duration training 7x 1.5 h. 12 and 18 months follow-up.</p>	<p>Waiting list</p>	<p>Participation rate: no</p>	<p>Daily LBP intensity, satisfaction with ADL, pain related absenteeism.</p>	<p>intervention groups in up to 18 months. Perceived physical exertion at work was reduced in the physical training group.</p>	<p>Intervention group had significant improvements for pain intensity, anxiety, sleep quality and fatigue ratings, observed pain, behaviour activities, mood and helplessness. No significant change in sickness absence.</p>
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Fanello S. 2002 (13)	RCT	Stratification on job categories, Nursing assistants, nurses and cleaning staff at a hospital. N=272 Age=37 years, gender?	Intervention: Theoretical instruction in patient handling. After 3 and 6 months the investigators observed the employees at work, over two consecutive days, providing them with further advice, as needed on good practices for normal handling.	No further advice or instruction	89%	LBP, LBP duration.	LBP remission rate were higher in the intervention group. Shorter duration of LBP at follow-up.	
<b>Physical exercise</b> Gundewall B. 1993 (14)	RCT: stratified then random allocation to two groups.	Nurses and nurses aides in a geriatric ward with and without back pain, N=69, Females n=68. Age 18-58 years	Intervention: exercise during work hours; endurance, coordination and muscle strength (6 sessions/month in 13 months). 13-months follow-up	Control: no further advice or instruction	Participation Rate: no	LBP intensity Number of days with LBP Absent from work due LBP (days).	Reduction of LBP prevalence, LBP intensity and days lost from work.	

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