ORIGINAL RESEARCH

Who maintains good health functioning? The contribution of social, work-related and behavioural factors to mental and physical health functioning trajectories in ageing employees

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ABSTRACT

Objectives The determinants of poor functioning and subsequent early exit from work are well established but very little is known about the positive determinants of maintaining good functioning among the ageing workforce. We investigated modifiable determinants of maintaining good mental and physical health functioning.

Methods We used prospective survey data collected across four waves among the midlife employees of the City of Helsinki, Finland, 2000–2017 (n=3342). Health functioning was repeatedly measured using the Short Form 36 (SF-36) inventory. Trajectories of mental and physical health functioning were separately examined using group-based trajectory analysis. Multinomial logistic regression models were fitted to examine determinants of each trajectory.

Results Four trajectory solutions for the developmental patterns in health functioning during the follow-up period were selected, with a slightly different shape of the first trajectory for mental and physical functioning: (1) continuously low (mental), low and decreasing (physical), (2) increasing, (3) decreasing and (4) continuously high functioning. After adjustments, the employees in the continuously high mental health functioning group were more likely to have optimal job demands, high job control, no sleep problems and no binge drinking behaviour. Employees in the continuously high physical functioning group had more likely low levels of physically strenuous work and hazardous working environment and no sleep problems and normal weight.

Conclusion High job control, good sleep and avoiding binge drinking may help maintain good mental health functioning. Low levels of physical or environmental work exposures, good sleep and recommended healthy weight may support maintenance of good physical health functioning among ageing employees.

INTRODUCTION

In ageing populations, such as in Finland, the proportion of working-age people is rapidly decreasing. In this context, extending working careers, promoting good health functioning at work and avoiding early exit from paid employment are key challenges.1-3 Health functioning reflects health status in general, and the ability to perform everyday tasks.4-7 It is important to increase our understanding about the determinants of different domains of health functioning as they predict sickness absence,8,9 while sickness absence in turn is a marker of future disability pension.10 In particular, understanding who maintains good health functioning at work and examining the role of the potentially modifiable determinants of health functioning may help us intervene appropriately and thereby improve workplace.
| Table 1  | Descriptive statistics of the study population by mental health functioning (MCS) trajectory group assignment*. The Helsinki Health Study |
|---------|----------------------------------------------------------------------------------------------------------------------------------|
| **MCS trajectory group** | **Continuous low** | **Increasing** | **Decreasing** | **Stable high** | **Total** | **P value** |
| %     | Col % | Col % | Col % | Col % | Col % |  |
| n     | 130   | 254   | 455   | 2503  | 3342  |  |
| Age   | Mean  | 44    | 45    | 44    | 45    | 45 |
| **PCS trajectory group** | | | | | | |
| Low and decreasing | 13 | 7 | 9 | 6 | 7 |
| Increasing | 6 | 5 | 6 | 4 | 4 |
| Decreasing | 35 | 28 | 30 | 23 | 25 |
| Stable high | 46 | 61 | 55 | 67 | 64 |
| **Gender** | | | | | | |
| Men | 22 | 22 | 17 | 16 | 17 |
| Women | 78 | 78 | 83 | 84 | 83 |
| **Marital status** | | | | | | |
| Co-habiting/married | 53 | 67 | 68 | 73 | 71 |
| Never married/divorced/widowed | 46 | 32 | 32 | 27 | 28 |
| Missing | 1 | 1 | 0 | 1 | 0 |
| **Occupational class** | | | | | | |
| Managers and professionals | 37 | 36 | 31 | 29 | 30 |
| Semi-professionals | 16 | 23 | 22 | 24 | 23 |
| Routine non-manual workers | 29 | 28 | 32 | 33 | 33 |
| Manual workers | 15 | 11 | 14 | 12 | 12 |
| Missing | 2 | 2 | 1 | 1 | 1 |
| **Shift or night work** | | | | | | |
| No | 78 | 84 | 80 | 81 | 81 |
| Shift or night work | 22 | 15 | 19 | 18 | 18 |
| Missing | 1 | 1 | 0 | 1 | 1 |
| **Long working hours (more than 40 h/w)** | | | | | | |
| No | 85 | 82 | 87 | 84 | 84 |
| Long working hours (more than 40 h/w) | 14 | 17 | 11 | 14 | 14 |
| Missing | 1 | 1 | 2 | 1 | 1 |
| **Work demand** | | | | | | |
| High | 81 | 83 | 82 | 71 | 73 |
| Optimal work demand | 19 | 17 | 18 | 29 | 26 |
| Missing | 0 | 0 | 0 | 1 | 1 |
| **Work control** | | | | | | |
| Low | 83 | 81 | 79 | 76 | 77 |
| High work control | 17 | 19 | 21 | 24 | 23 |
| Missing | 0 | 0 | 0 | 0 | 0 |
| **Physically strenuous work** | | | | | | |
| No | 80 | 78 | 81 | 73 | 74 |
| Low level of physically strenuous work | 18 | 21 | 18 | 27 | 25 |
| Missing | 2 | 0 | 1 | 1 | 1 |
| **Hazardous working environment** | | | | | | |
| No | 80 | 80 | 77 | 73 | 74 |
| Low level of hazardous working environment | 18 | 20 | 22 | 26 | 25 |
| Missing | 2 | 0 | 1 | 1 | 1 |
| **Sleep problems** | | | | | | |
| No | 43 | 66 | 79 | 87 | 82 |
| Sleep problems | 55 | 32 | 18 | 11 | 15 |
| Missing | 2 | 2 | 3 | 2 | 3 |
| **Smoking** | | | | | | |
| No | 48 | 52 | 43 | 55 | 53 |
| Past smoking | 20 | 22 | 29 | 23 | 24 |

continued
good health functioning and work participation among ageing employees.

Previous studies have extensively focused on the risk factors of poor functioning and related sickness absence, as well as early exit from paid employment,11–13 while the evidence about the positive determinants of maintaining good functioning among the ageing workforce is much more limited. In addition, most of the evidence comes from studies which have used variable oriented methods, that is, have assessed associations between a pre-defined predictor and a dichotomous (such as disability pension) or count outcomes (such as sickness absence).14–15

However, identifying groups of employees who follow similar developmental patterns in their functioning over time may reveal additional insights for efforts to identify factors supporting maintenance of the good functioning in later working life. For example, using group-based trajectory analysis (GBTA) enables to identify trajectories from the data,16–18 and possibly reveal a group that is able to maintain good health functioning.

Socioeconomic factors are important determinants of health functioning17,18; people with low education and low occupational class experience the greatest decline in their health and functioning as they age.19,20 Moreover, as the social patterning of physical and mental health appears to vary,21 physical and mental health functioning should be examined separately. This helps confirm if trajectories in physical and mental health functioning, and their determinants, also vary. Additionally, behavioural factors such as binge drinking, smoking, obesity and poor sleep have been shown to contribute to health functioning,11,22,23 and could be assumed to contribute to memberships to the distinct trajectory groups.

### Table 1

|                      | Continuously low | Increasing | Decreasing | Stable high | Total |
|----------------------|------------------|------------|------------|-------------|-------|
|                      | Col %            | Col %      | Col %      | Col %       | Col % |
| Current smoking      | 32               | 26         | 28         | 21          | 23    |
| Missing              | 0                | 1          | 0          | 0           | 0     |
| Binge drinking       |                  |            |            |             |       |
| No                   | 75               | 81         | 87         | 90          | 89    |
| Missing              | 2                | 2          | 2          | 1           | 2     |
| Binge drinking (once a week or more) | 22 | 16 | 11 | 8 | 10 <0.001 |
| Missing              | 2                | 2          | 2          | 1           | 2     |

|                      | Col %            | Col %      | Col %      | Col %       | Col % |
|----------------------|------------------|------------|------------|-------------|-------|
| Obesity              |                  |            |            |             |       |
| Normal weight        | 55               | 60         | 60         | 61          | 60    |
| Overweight           | 33               | 28         | 30         | 29          | 29    |
| Obesity              | 11               | 10         | 9          | 10          | 10    |
| Missing              | 2                | 1          | 1          | 0           | 1     |

*All predictors measured at baseline. Missing category omitted from the $\chi^2$ test.

h/w, hours/week; MCS, Mental Component Summary; PCS, Physical Component Summary.

Figure 1  Upper part: estimated mental health functioning trajectory shapes and the mean scores (left figure) and interquartilerange (IQR) at baseline and follow-ups of each trajectory group (right figure). Lower part: estimated physical health functioning trajectory shapes and the mean scores (left figure) and IQR at baseline and follow-ups of each trajectory group (right figure).
Table 2  Results from multinomial regression model for mental health functioning (Mental Component Summary, MCS) trajectory assignment

| MCS trajectory group | Continuously low | Increasing | Decreasing | Stable high |
|----------------------|------------------|------------|------------|-------------|
| AME (95% CI)         | AME (95% CI)     | AME (95% CI) | AME (95% CI) | AME (95% CI) |
| Gender               |                  |            |            |             |
| Men                  | Ref.             | Ref.       | Ref.       | Ref.        |
| Women                | −0.00 (−0.02 to 0.01) | −0.02 (−0.05 to 0.00) | −0.01 (−0.04 to 0.03) | 0.03 (−0.01 to 0.08) |
| Marital status       |                  |            |            |             |
| Co-habiting/married  | Ref.             | Ref.       | Ref.       | Ref.        |
| Never married/divorced/widowed | 0.03*** (0.01 to 0.05) | 0.01 (−0.01 to 0.03) | 0.02 (−0.00 to 0.05) | −0.07*** (−0.10 to −0.03) |
| Occupational class   |                  |            |            |             |
| Managers and profesionals | Ref.        | Ref.      | Ref.       | Ref.        |
| Semi-professionals   | −0.03** (−0.05 to −0.01) | −0.01 (−0.04 to 0.01) | −0.03 (−0.06 to 0.01) | 0.07*** (0.03 to 0.11) |
| Routine non-manual workers | −0.02 (−0.05 to −0.00) | −0.03 (−0.05 to 0.00) | −0.03 (−0.07 to 0.00) | 0.08*** (0.04 to 0.12) |
| Manual workers       | −0.02 (−0.05 to 0.00) | −0.03* (−0.06 to −0.00) | −0.03 (−0.07 to 0.01) | 0.09*** (0.04 to 0.14) |
| Shift or night work  |                  |            |            |             |
| No                   | Ref.             | Ref.       | Ref.       | Ref.        |
| Shift or night work  | 0.01 (−0.01 to 0.03) | −0.02 (−0.04 to 0.01) | 0.00 (−0.03 to 0.03) | 0.01 (−0.03 to 0.04) |
| Long working hours (more than 40 h/w) | No | Ref. | Ref. | Ref. | Ref. |
| Long working hours   | 0.00 (−0.02 to 0.01) | 0.01 (−0.02 to 0.03) | −0.04* (−0.07 to −0.00) | 0.03 (−0.01 to 0.07) |
| Work demand (lowest 25%) | No | Ref. | Ref. | Ref. | Ref. |
| Optimal work demand  | −0.01 (−0.02 to 0.01) | −0.03** (−0.05 to −0.01) | −0.06*** (−0.08 to −0.03) | 0.09*** (0.06 to 0.12) |
| Work control (highest 25%) | No | Ref. | Ref. | Ref. | Ref. |
| High work control    | −0.01 (−0.03 to 0.00) | −0.02* (−0.04 to −0.00) | −0.02 (−0.04 to 0.01) | 0.05** (0.02 to 0.08) |
| Physically strenuous work (lowest 25%) | No | Ref. | Ref. | Ref. | Ref. |
| Low level of physically strenuous work | −0.01 (−0.03 to 0.00) | −0.02* (−0.04 to −0.00) | −0.04** (−0.07 to −0.02) | 0.08*** (0.04 to 0.11) |
| Hazardous working environment (lowest 25%) | No | Ref. | Ref. | Ref. | Ref. |
| Low level of hazardous working environment | −0.00 (−0.02 to 0.01) | −0.01 (−0.03 to 0.01) | −0.01 (−0.04 to 0.02) | 0.03 (−0.01 to 0.06) |
| Sleep problems       |                  |            |            |             |
| No                   | Ref.             | Ref.       | Ref.       | Ref.        |
| Sleep problems       | 0.11*** (0.08 to 0.14) | 0.09*** (0.06 to 0.12) | 0.03 (−0.00 to 0.07) | −0.23*** (−0.28 to −0.19) |
| Smoking              |                  |            |            |             |
| Never                | Ref.             | Ref.       | Ref.       | Ref.        |
| Past smoking         | −0.01 (−0.02 to 0.01) | −0.01 (−0.03 to 0.01) | 0.06*** (0.03 to 0.09) | −0.04* (−0.08 to −0.01) |
| Smoking              | 0.01 (−0.01 to 0.02) | 0.01 (−0.02 to 0.03) | 0.06*** (0.02 to 0.09) | −0.07*** (−0.11 to −0.03) |
| Binge drinking       |                  |            |            |             |
| No                   | Ref.             | Ref.       | Ref.       | Ref.        |
| Binge drinking (once a week or more) | 0.04** (0.01 to 0.07) | 0.04* (0.01 to 0.08) | 0.01 (−0.03 to 0.05) | −0.10*** (−0.15 to −0.05) |
| Obesity              |                  |            |            |             |
| Normal weight        | Ref.             | Ref.       | Ref.       | Ref.        |
| Overweight           | 0.01 (−0.01 to 0.02) | −0.01 (−0.03 to 0.01) | 0.01 (−0.02 to 0.03) | −0.00 (−0.04 to 0.03) |
| Obesity              | −0.00 (−0.02 to 0.02) | −0.01 (−0.04 to 0.02) | −0.01 (−0.05 to 0.03) | 0.02 (−0.03 to 0.07) |

AMEs and their 95% CI for each group.

*P<0.05, **P<0.01, ***P<0.001 for the difference compared to reference category. Additionally adjusted for age.

AME, average marginal effect; h/w, hours/week.

Therefore, the present study aims to identify trajectories of mental and physical health functioning among midlife and ageing employees and then to investigate their social (age, gender, marital status, occupational class), work-related (physical and psychosocial working conditions) and behavioural (smoking, drinking, obesity, sleep) determinants. A special focus is to recognise potential modifiable predictors (such as working conditions and behavioural factors) of maintenance of good mental and physical health functioning.

METHODS

Data

We used prospective survey data of public sector employees of the City of Helsinki, Finland, followed up in three to four years. The data included three survey waves, with the last wave performed approximately 4 years after the first. We used the data from the last survey wave to analyse workplace health trajectories.

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### Table 3  Descriptive statistics of the study population by physical health functioning* (Physical Component Summary, PCS) trajectory group assignment*. The Helsinki Health Study

| PCS trajectory group | Low and decreasing | Increasing | Decreasing | Stable high | P value |
|----------------------|--------------------|-----------|------------|-------------|---------|
| %                    | 7                  | 4         | 25         | 64          |         |
| n                    | 226                | 148       | 840        | 2128        |         |
| Age                  |                    |           |            |             |         |
| Mean                 | 45                 | 45        | 44         | 45          |         |
| Mental Component Summary (MCS) trajectory group | | | | | |
| Continuously low     | 8                  | 5         | 5          | 3           | <0.001  |
| Increasing           | 8                  | 8         | 8          | 7           | <0.001  |
| Decreasing           | 19                 | 19        | 16         | 12          |         |
| Stable high          | 66                 | 68        | 70         | 78          |         |
| Gender               |                    |           |            |             |         |
| Men                  | 12                 | 19        | 13         | 19          | <0.001  |
| Women                | 88                 | 81        | 87         | 81          | <0.001  |
| Marital status       |                    |           |            |             |         |
| Co-habiting/married  | 57                 | 67        | 68         | 74          |         |
| Never married/divorced/widowed | 42 | 33 | 31 | 26 | <0.001 |
| Missing              | 0                  | 0         | 1          | 0           |         |
| Occupational class   |                    |           |            |             |         |
| Managers and professionals | 21 | 28 | 22 | 35 |         |
| Semi-professionals   | 14                 | 22        | 21         | 25          | <0.001  |
| Routine non-manual workers | 44 | 36 | 38 | 29 |         |
| Manual workers       | 20                 | 14        | 17         | 10          |         |
| Missing              | 1                  | 1         | 1          | 1           |         |
| Shift or night work  |                    |           |            |             |         |
| No                   | 79                 | 81        | 77         | 83          |         |
| Shift or night work  | 20                 | 19        | 22         | 16          | 0.001   |
| Missing              | 1                  | 0         | 1          | 1           |         |
| Long working hours   |                    |           |            |             |         |
| No                   | 86                 | 82        | 87         | 84          |         |
| Long working hours (more than 40 h/w) | 13 | 16 | 12 | 15 | 0.165 |
| Missing              | 1                  | 0         | 1          | 2           |         |
| Work demand          |                    |           |            |             |         |
| High                 | 75                 | 83        | 76         | 72          |         |
| Optimal work demand  | 24                 | 16        | 23         | 28          | 0.001   |
| Missing              | 0                  | 1         | 1          | 0           |         |
| Work control         |                    |           |            |             |         |
| Low                  | 81                 | 81        | 82         | 74          |         |
| High work control    | 18                 | 19        | 18         | 26          | <0.001  |
| Missing              | 1                  | 0         | 1          | 0           |         |
| Physically strenuous work | 89 | 83 | 83 | 69 |         |
| Low level of physically strenuous work | 10 | 16 | 16 | 31 | <0.001 |
| Missing              | 1                  | 1         | 1          | 1           |         |
| Hazardous working environment | 83 | 79 | 79 | 71 |         |
| Low level of hazardous working environment | 16 | 20 | 21 | 28 | <0.001 |
| Missing              | 1                  | 1         | 1          | 1           |         |
| Sleep problems       |                    |           |            |             |         |
| No                   | 68                 | 65        | 77         | 87          |         |
| Sleep problems       | 29                 | 32        | 20         | 10          | <0.001  |
| Missing              | 3                  | 3         | 2          | 2           |         |
| Smoking              |                    |           |            |             |         |

continued
surveys through 2000 to 2017 (the Helsinki Health Study, HHS). At baseline in 2000–2002, the participants of the original HHS cohort were aged 40–60 years, and they were all employed by the City of Helsinki (n=8960). The City of Helsinki is the largest employer in Finland, and there are hundreds of different occupational titles from routine manual work to administrative and professional positions. The largest branches include, for example, social and healthcare, and physical work is prevalent, for example, in many manual jobs and in care work. The target population was all employees reaching 40, 45, 50, 55 or 60 years of age at baseline in 2000, 2001 or 2002. Inclusion and exclusion criteria and details about recruitment, non-response and attrition and have been described earlier. For the current study, we included only participants aged 40–55 at baseline who were continuously employed and had no missing data on their health functioning (component summary scores) in at least three of the four surveys (conducted in 2000–2002, 2007, 2012 and 2017, response rates 67%, 83%, 79% and 82%, respectively) (see the inclusion criteria in online supplementary figure S1, displayed as a flow chart). The age restriction was done to have an adequate number (ie, three) of measurement points while still employed. The final analytic sample consisted of 3342 employees.

Measures

Health functioning
Mental and physical health functioning were measured at baseline and follow-up waves using the Short Form 36 (SF-36) inventory. We used a validated Finnish translation of this inventory. The inventory includes altogether 36 items that form eight subscales, although some concern about the summary scores also exist. Nonetheless, the inventory has good psychometric properties, high internal consistency and construct validity, and high test-retest reliability. For the purposes of this study, we decided to model the development trajectories using the component scores. The scores were constructed to have a mean of 50 and SD of 10 in the general population. Higher scores indicate better functioning.

Social determinants
All predictors of the trajectories were measured at baseline in 2000–2002. We included gender (1=man, 2=woman), age (continuous) and marital status (married/cohabiting vs others) as sociodemographic factors. Occupational class as an indicator of socioeconomic position was derived from the employer’s personnel register for those with a consent for such linkage (78%), and completed from the questionnaire survey responses for the rest. Self-reported occupational titles were classified according to the register data. Occupational class was then divided into managers and professionals, semi-professionals, routine non-manual workers and manual workers.

Work-related factors
Working conditions were measured as supporting positive factors and dummy variables were coded to represent the most optimal approximate quartile in each scale. Job demands and job control were measured by the Framingham version of Karasek’s Job Content Questionnaire. The weighted mean of demands and control scales were calculated for those responding over half of the corresponding questions (3 or more/5 for job demands and 5 or more/9 for job control). Then those scoring approximately in the highest quartile in the job control scale were defined as having high job control, and those scoring approximately in the lowest quartile in the job demands scale were defined having optimal job demands.

Good physical working conditions included low level of physically strenuous work and low level of hazardous working environment. The employees were asked about the presence of 18 physical working conditions (an 18-item questionnaire developed at the Finnish Institute of Occupational Health, FIOH)
with four response options: (1) not present; (2) present, but does
not bother at all; (3) present and somewhat bothers; (4) present
and bothers a lot. For those with four or less missing items, any
missing items were replaced by the sample mode of that item.
Then, following our previous studies, a factor analysis
was conducted, and a three-factor solution was selected: physical
workload factors (loading the following items: awkward
working positions, rotation of the back, repetitive movements,
standing, walking and heavy physical effort or lifting and
carrying) and hazardous working environment (noise, vibration,
weak or disruptive lighting, solvents, gasses or irritants, warmth,
coldness or changes in temperature, dryness of air, dirt, damp-
ness or wetness, mould). The third factor comprised sedentary
work/working with computer (working at monitor and using
a computer mouse), but it was omitted because we focused
on physical working conditions, and the third factor mainly
concerns non-physical work. The factor scores were dichoto-
mised and employees in the lowest quartile (25%) in each scale
were defined as having no physically strenuous work and no
hazardous working environment.

Working time pattern was measured by adverse working times
(night/shift work weekdays or weekends vs others) and overtime
(reporting average working time more than 40 hours per week
vs others).

Behavioural factors

Behavioural determinants were self-reported and included base-
line smoking, drinking, obesity and poor sleep. Smoking was
divided into never smoking, past smoking and current smoking.
Binge drinking was indicated by drinking six or more units of
alcohol on a single occasion once a week or more often. Body
mass index (BMI) was defined based on height and weight and
then divided into three groups: normal weight (BMI <25), over-
weight (25≤BMI< 30) and obese (BMI≥30). Sleep problems were
measured by a 4-item version of the Jenkins question-
naire and those respondents reporting at least one of the four
symptoms occurring more than 14 days in the past 4 weeks were
classified as having a sleep problems. Those with more than
one item missing from the four questions were set to missing.

Statistical analyses

Trajectories of health functioning were examined using a GBTA.
GBTA is used to identify distinct groups of the study population,
who have similar trajectories over the study period. Health
functioning component scores were used as repeated outcomes
with a normal distribution. The method uses maximum likely-
hood and participant with maximum of one missing outcome
score (ie, those with three valid survey responses) are included
with missing at random assumption. Next, shapes of the trajecto-
ries were defined. As health functioning may not develop linearly
with time, we tested the fit also with second degree polynomial
curves. The optimal number of trajectory groups was chosen
based on the Bayesian information criteria and distinct inter-
pretation and reasonable sizes of trajectory groups were also
required (online supplementary tables S1 and S2). Participants
were assigned to the trajectory group for which their probability
of group membership was highest. The average group member-
ship probabilities for each group in comparison to the assigned
group membership are shown in online supplementary tables S3
and S4. For both trajectory analyses, the model indicated good
fit with distinct trajectories with high average group membership
probabilities (0.93 for the selected group for mental functioning
trajectories and 0.90 for physical functioning trajectories). The
trajectory analyses thus produced clearly distinct groups, and
particularly the trajectory describing continuously high func-
tioning is distinct from the other groups, with higher group
membership probabilities.

The composition of the trajectory groups was first descrip-
tively examined using cross-tabulations and χ² tests. Then,
multinomial logistic regression models were used to examine the
determinants of the trajectory group membership. A single model
was fitted adjusting for all covariates. To illustrate differences in
predicted probabilities for each trajectory group membership,
we report average marginal effects (AMEs) and their 95% CI.
Reporting marginal effects was chosen over showing odds ratios
(ORs), as the proportions are concrete and more clearly show
the actual difference between groups, compared to less tangible
ORs.

There were no systematic differences by sex, and thus all anal-
yses were run in pooled data.

Missing values

Around 9% of the sample had some missing values in the predic-
tors. First, we explored patterns of missingness, and then the
missingness was imputed using multiple imputations by chained
equations and created 20 datasets. This method was selected, as
by using multiple imputations by chained equations, we can take
into account missing values that are related to other predictors.
We considered this as a better option than omitting all those with
missing values. We used all predictors and trajectory groups in
the imputation process and multinomial and logistic regression
were used when appropriate. The results from complete case
analysis, however, provided consistent and fairly similar results.

RESULTS

Mental health functioning

Figure 1 presents the estimated trajectory groups and their
means and interquartilerange (IQR) of mental health func-
tioning scores. We identified four mental health functioning
trajectories within the 17 year follow-up period: continuously
low (4%), increasing (8%), decreasing (14%) and a stable high
trajectory which represents maintaining good mental health
functioning (75%) (figure 1 and table 1). Employees in the
stable high group were more likely to report optimal job
requirements (table 1). There were no differences in mental health
functioning trajectories between BMI groups. Finally, those
who were able to maintain good mental health functioning
were also more likely to maintain good physical health func-
tioning (table 1).

After mutual adjustments, those with optimal job demands
(AME for optimal job demands 0.09 (95% CI 0.06 to 0.12)),
high job control (0.05 (0.02 to 0.08)), no sleeping problems
(−0.23 (−0.28 to −0.19)) and no binge drinking (−0.10 (−0.15
to 0.05)) at baseline were more likely to maintain good mental
health functioning during their later working years. Further-
more, having low level of physical work (0.08 (0.04 to 0.11))
and not smoking (AME for current smoking −0.07 (−0.11 to
−0.03)) were linked to a slightly higher likelihood to maintain
good mental health functioning (table 2).
Physical health functioning
In terms of physical health functioning, an almost similar four trajectory solution was identified and selected as the best model: low and decreasing (7%), increasing (4%), decreasing (25%) and a stable high trajectory reflecting maintenance of good mental health functioning (64%) (figure 1 and table 3). Individuals maintaining good physical health functioning were more likely to report no shift/night work; good psychosocial and low levels of adverse physical working conditions were also more common in this group. Behavioural factors, that is, smoking, sleep problems, overweight and obesity were less common among those assigned to the stable high physical health functioning trajectory, compared to those assigned to the other trajectory groups (table 3). Finally, it is of note that male employees were more likely to maintain good physical health functioning.

| Table 4 | Results from multinomial regression model for physical health functioning (Physical Component Summary, PCS) trajectory assignment |
|-----------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-----------------------------------------------|
| PCS trajectory group | Low and decreasing | Increasing | Decreasing | Stable high |
| AME (95% CI) | AME (95% CI) | AME (95% CI) | AME (95% CI) |
| **Gender** | | | | |
| Men | Ref. | Ref. | Ref. | Ref. |
| Women | 0.03** (0.01 to 0.05) | −0.01 (-0.03 to 0.01) | 0.06** (0.02 to 0.10) | −0.08*** (-0.12 to −0.04) |
| **Marital status** | | | | |
| Co-habiting/married | Ref. | Ref. | Ref. | Ref. |
| Never married/divorced/widowed | 0.03** (0.01 to 0.05) | 0.01 (-0.01 to 0.02) | 0.01 (-0.02 to 0.04) | −0.04 (-0.08 to −0.01) |
| **Occupational class** | | | | |
| Managers and professionals | Ref. | Ref. | Ref. | Ref. |
| Semi-professionals | −0.02 (-0.04 to 0.00) | −0.00 (-0.02 to 0.02) | 0.01 (-0.03 to 0.05) | 0.01 (-0.03 to 0.06) |
| Routine non-manual workers | 0.01 (-0.01 to 0.04) | 0.01 (-0.01 to 0.03) | 0.04 (0.00 to 0.09) | −0.07 (-0.11 to −0.02) |
| Manual workers | 0.02 (-0.01 to 0.05) | −0.00 (-0.03 to 0.02) | 0.08** (0.02 to 0.13) | −0.10*** (-0.15 to −0.04) |
| **Shift or night work** | | | | |
| No | Ref. | Ref. | Ref. | Ref. |
| Shift or night work | −0.00 (-0.02 to 0.02) | −0.00 (-0.02 to 0.01) | 0.03 (-0.01 to 0.07) | −0.03 (-0.07 to 0.01) |
| **Long working hours (more than 40 h/w)** | | | | |
| No | Ref. | Ref. | Ref. | Ref. |
| Long working hours | −0.00 (-0.03 to 0.02) | 0.00 (-0.02 to 0.02) | −0.03 (-0.07 to 0.01) | 0.03 (-0.02 to 0.07) |
| **Work demand (−lowest 25%)** | | | | |
| No | Ref. | Ref. | Ref. | Ref. |
| Optimal work demand | −0.00 (-0.02 to 0.01) | −0.02** (-0.04 to −0.01) | −0.04** (-0.07 to −0.01) | 0.07*** (0.03 to 0.10) |
| **Work control (−highest 25%)** | | | | |
| No | Ref. | Ref. | Ref. | Ref. |
| High work control | −0.00 (-0.02 to 0.02) | −0.01 (-0.02 to 0.01) | −0.04 (-0.08 to −0.00) | 0.05** (0.01 to 0.08) |
| **Physically strenuous work (lowest 25%)** | | | | |
| No | Ref. | Ref. | Ref. | Ref. |
| Low level of physically strenuous work | −0.04*** (-0.06 to −0.03) | −0.02* (-0.03 to −0.00) | −0.07*** (-0.11 to −0.04) | 0.13*** (0.09 to 0.17) |
| **Hazardous working environment (lowest 25%)** | | | | |
| No | Ref. | Ref. | Ref. | Ref. |
| Low level of hazardous working environment | −0.02*** (-0.04 to −0.01) | −0.01 (-0.02 to 0.01) | −0.04 (-0.07 to −0.00) | 0.07*** (0.03 to 0.10) |
| **Sleep problems** | | | | |
| No | Ref. | Ref. | Ref. | Ref. |
| Sleep problems | 0.06*** (0.03 to 0.09) | 0.05** (0.03 to 0.08) | 0.09*** (0.04 to 0.13) | −0.20*** (-0.24 to −0.15) |
| **Smoking** | | | | |
| Never | Ref. | Ref. | Ref. | Ref. |
| Past smoking | 0.02 (-0.00 to 0.04) | 0.01 (-0.01 to 0.02) | 0.01 (-0.02 to 0.05) | −0.04 (-0.08 to 0.00) |
| Smoking | 0.02 (-0.00 to 0.04) | 0.00 (-0.02 to 0.02) | 0.05 (-0.01 to 0.09) | −0.07*** (-0.11 to −0.03) |
| **Binge drinking** | | | | |
| No | Ref. | Ref. | Ref. | Ref. |
| Binge drinking (once a week or more) | 0.02 (-0.01 to 0.05) | −0.01 (-0.03 to 0.02) | 0.01 (-0.04 to 0.06) | −0.02 (-0.08 to 0.03) |
| **Obesity** | | | | |
| Normal weight | Ref. | Ref. | Ref. | Ref. |
| Overweight | 0.02** (0.01 to 0.04) | 0.02** (0.01 to 0.04) | 0.07*** (0.03 to 0.10) | −0.12*** (-0.15 to −0.08) |
| Obesity | 0.12*** (0.08 to 0.16) | 0.03 (-0.00 to 0.05) | 0.13*** (0.07 to 0.18) | −0.27*** (-0.33 to −0.22) |

AMEs and their 95% CI for each group.
*P<0.05, **P<0.01, ***P<0.001 for the difference compared to reference category. Additionally adjusted for age. AME, average marginal effect.
After adjustments (table 4), particularly those with low levels of physically strenuous work (0.13 (0.09 to 0.17)), low levels of hazardous working environment (0.07 (0.03 to 0.10)), good sleep (−0.20 (−0.24 to −0.15)), non-smoking (−0.07 (−0.11 to −0.03)) and normal weight (−0.27 (−0.33 to −0.22) compared to obesity and −0.12 (−0.15 to −0.08) overweight) at baseline were significantly more likely to maintain good physical health functioning during their later working life span.

**DISCUSSION**

This study was set to identify mental and physical health functioning trajectories among midlife employees. More specifically, the aim was to examine who maintains good health functioning during later working life span, and what are the determinants of the different developmental patterns in health functioning from midlife towards the end of working careers. We focused on the potentially modifiable determinants of the trajectory memberships, that is, working conditions and behavioural factors, which could be targeted to help employees maintain good physical and mental functioning and continue working until the statutory retirement age and even beyond.

For both mental and physical health functioning, a four trajectory model was chosen. Thus, we identified groups of employees who follow similar developmental trajectories in their functioning over the period of up to 17 years, with a slight difference only regarding the first distinct group: (1) continuously low functioning (for mental functioning), low and decreasing (for physical functioning); (2) decreasing; (3) increasing and (4) stable high functioning which reflects maintenance of health functioning throughout the follow-up. There are some differences in the prevalence and shapes of the trajectories regarding physical and mental functioning, but for both outcomes, there was a distinct group of stable high functioning. Good sleep and non-smoking were the key determinants for maintaining both mental and physical health functioning. For maintaining a good mental health functioning, particularly good psychosocial working conditions and avoiding binge drinking emerged as key determinants, whereas having low physical and environmental exposures and normal weight supported maintenance of good physical functioning.

Although modifiable determinants of the development trajectories of health functioning are poorly understood among older employees, these results confirm the significance of good working conditions, good sleep and healthy lifestyle to good functioning, and thereby a lower risk of work disability. However, previous evidence is from studies where the focus has been on the associations between variables, while determinants of developmental trajectories of health functioning among midlife employees have not been studied. As all participants continued working throughout the follow-up, we could identify groups of employees, who are likely to follow similar development in their health functioning over time, and investigate the determinants of trajectory group memberships. As poor functioning is linked to sickness absence and early exit from paid employment, people in different trajectory groups subsequently differ in their abilities to be able to continue working until the statutory retirement age. By focusing on potentially modifiable determinants of trajectory memberships, the results can be used in efforts to support maintenance of work ability, and in interventions to modify demanding or hazardous working conditions, for example.

Further elaboration on the mechanisms through which the examined determinants are linked to physical or mental health functioning trajectories is a crucial point for the future. As this is an observational study, we are careful not to provide causal interpretation of our results (including speculating potential mechanisms). Nonetheless, we have shown associations and identified and highlighted groups at risk which might be targeted, for example, in intervention studies. We are not aware of previous studies that had focused on maintenance of functioning using person-oriented methods, and the determinants of the trajectory memberships.

A limitation of this observational and descriptive study is that only survey data were available, and thus there could be reporting bias in both determinants and outcome measures. Another limitation is that all employees worked in the public sector and for one employer, and the sample is not representative of the national working population of the same age range. Thus, generalisability to other sectors could be limited. It is also of note that although the identified trajectories were found to be reliable (online supplementary table), misclassification cannot be ruled out and trajectory memberships are only approximations. The true development may be different for any member of any of the trajectories. Many factors could also contribute to either an increase or a decrease in physical and mental health functioning during the 15-year to 17-year follow-up, from midlife towards the end of the working life span but detailed investigations of such factors go beyond those included in this study. Additionally, health of the participants likely varies within and between trajectories, but this was not considered. Our outcome is health functioning, and the focus is on the modifiable predictors of developmental patterns in health functioning. These are likely intertwined with health in complex ways, but partly measure the same thing, that is, health functioning is a general health measure. Health status was therefore not included in the models to avoid overadjustment.

A strength of this study is its follow-up design with up to four time points for each individual, which enabled us to reliably examine developmental trajectories in health functioning during a long period of time, from midlife towards statutory retirement age. Furthermore, response rates at baseline were high, and attrition was low over the entire follow-up (response rates at follow-up surveys ranged from 67% to 82%). Thus, the sample likely was, and has remained representative of the target population. We had the validated SF-36 measure repeated at each time point, as well as work and behavioural related determinants of the trajectory memberships, using widely used and validated measures. A further strength is the use of a person-oriented method, helping to identify somewhat homogenous groups of employees, who are likely to follow a similar developmental trajectory in their functioning. The advantage is that then we could further identify factors that help explain maintenance of good functioning in particular. In variable oriented approaches commonly applied in previous studies, potential heterogeneity in the development patterns could be missed.

In conclusion, these results suggest that favourable psychosocial and physical working conditions are important determinants of maintaining good health functioning, as are keeping recommended healthy weight, avoiding binge drinking and smoking, as well as sleeping well. This is further likely to help people continue working until their normal retirement age or even longer, in line with the current efforts to extend working lives. Subsequent intervention studies could, for example, consider providing health promotion programmes that target health behaviours, and help maintain better sleep and recommended healthy weight. Moreover, interventions to modify work environment, paying particular attention to physical workload and
overall changes in workplace accommodations could be encouraged to maintain employees’ good health functioning.

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Contributors TL and AH conceived and designed the study, and AH analysed the data. TL prepared the first version of the manuscript. AH helped draft the manuscript. All authors (TL, AH, OP, MM, AK and OR) discussed the results and commented on the manuscript, and approved the submission of the final version.

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Competing interests TL has received a lecture fee from an Insurance Company Lähitapiola, regarding an invited talk in a seminar (in Finnish) they funded with another company Elo. The talk was about pain and work ability, and an overall talk, i.e., not related to this particular study.

Patient consent for publication Not required.

Ethics approval The Helsinki Health Study has been ethically approved by the City of Helsinki health authorities, and the Department of Public Health, University of Helsinki, Finland, ethical committee.

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