Predictors of Work Ability in Teachers and Office Workers

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Introduction

Work ability is defined as the sum of factors enables an employed person in a certain situation to manage her working demands successfully (Ilmarinen & Tempel, 2002). It can be looked at both as an individual resource according to well-being and health of the individual also as organisational resource, related to a higher quality of work. A high work ability is accompanied with a longer active work-life and therefore with low national costs for the social system (Hasselhorn & Müller, 2004). Premature retirement is one effect of decreased work ability (Tuomi, Huuhtanen, Nykyri & Ilmarinen, 2001).

The *work ability of teachers* is especially alarming from an occupational medical point of view and should be examined closely. Rates of premature retirement among German school teachers due to serious health disorders are consistently higher than those of other employees in public services (Statistisches Bundesamt, 2005). In Germany more than 90% of the teachers retire early from their job; most of them for health reasons and 50% of these again leave their job after getting psychosomatic or psychic diseases (Hillert & Schmitz, 2004). In 2004 only 26% of teachers reached normal retirement age, compared to 54% of other employees in public services (Statistisches Bundesamt, 2005). But it's not a specifically German problem (Brown, Gilmour & Macdonald, 2005; Schwarzer, Schmitz & Tang, 2000; Guglielmi & Tatrow, 1998).

The *occupational demands of teachers* are very well researched (Bauer, Stamm, Virnich, Wissing, Müller, Wirsching & Schaarschmidt, 2006; Dunham & Varma, 1998). But the effect of work-related and personal risks and resources on the work ability of teachers isn't well examined and a comparison with other professions is rare (Ilmarinen, 1999; Kyriacou, 1980, 2001). To evaluate the findings of teachers, it's necessary to compare their work ability with other occupational groups characterized by a similar level of psychological stress but different level of education, job specifications and work-related demands. Office workers were chosen. Too, they are identified by mainly psychological and social communicative requirements (Huang, Robertson & Chang, 2004).

In order to *maintain and promote the work ability* on a high level over the working life the identification of work-related and personal risks and resources (influence factors) is necessary. This requires a multidimensional approach which can take into account complex occupational and personality factors. Most of the former studies just worked with subjective questionnaires (Bauer et al., 2006; Clark & Thompson, 1995).

The *aim of this study* is to examine the work ability and their work-related and personal factors ('risk factors' and 'resources'), especially health factors in grammar school teachers in comparison to office workers. Secondly, it has to be tested which of these factors are relevant predictors for the poor and excellent work ability.

Methods

Participants

Subjects were an opportunity sample of 100 female grammar school teachers and 60 office workers recruited in Dresden (Federal Country of Saxony, Germany). The participants aged between 25 and 60 years (mean age: 44 ± 9 years). Teachers were recruited from grammar schools (response rate: 58.3%) and office workers in public facilities (response rate: 57.1%). The groups don't differ in age distribution or marital status (Table 1). The majority of women are married (teachers: 71%, office workers: 72%) and 20% of the teachers as well as 10% of the office workers are divorced. Education and professional training of the groups differ in the following ways. Without exception, all teachers completed a university education. All of them are employed as civil servants and 98% belong to the permanent staff. 32% of office workers obtained their school leaving exam, whereas only 17% completed a university education but most of them additionally had a vocational training. All office workers are employed as civil servants. More than 80% are permanent workers. Their job profile ranges from pure office work (mainly administration), organizational tasks and customer care to advisory service. All of them work on the computer more than 4 hours daily.

Table 1: *Anamnestic characteristics of teachers and office workers (means and standard deviations; frequencies [%])*

Anamnestic characteristics	Teachers (n = 100)	Office Workers (n = 60)	Significance p-value
Age [years]	44,6 ± 7,7	42,6 ± 8,8	.124
Marital status[%]			
- single	8	13	.123
- married	71	72	
- divorced	20	10	
- widowed	1	5	
Vocational education [%]			
- no vocational education	---	---	.000
- vocational training	---	73	
- polytechnic	---	10	
- university	100	17	

Study Design and Inventories

Work ability is a result of interaction between occupational (e.g. intensity of work, effort-reward-imbalance) and personal (e.g. coping, social competence, behaviour under stress), especially health factors (e.g. vitality, complaints, burnout risk). Therefore, an integrated occupational medical and psychological research method was used to find out predictors for poor and excellent work ability (Figure 1). This multidimensional method consists of objective (physiological measures) and subjective (questionnaires, structured

interview) instruments for the assessment the work ability and the working-related and personal factors - inclusive the health status (vitality).

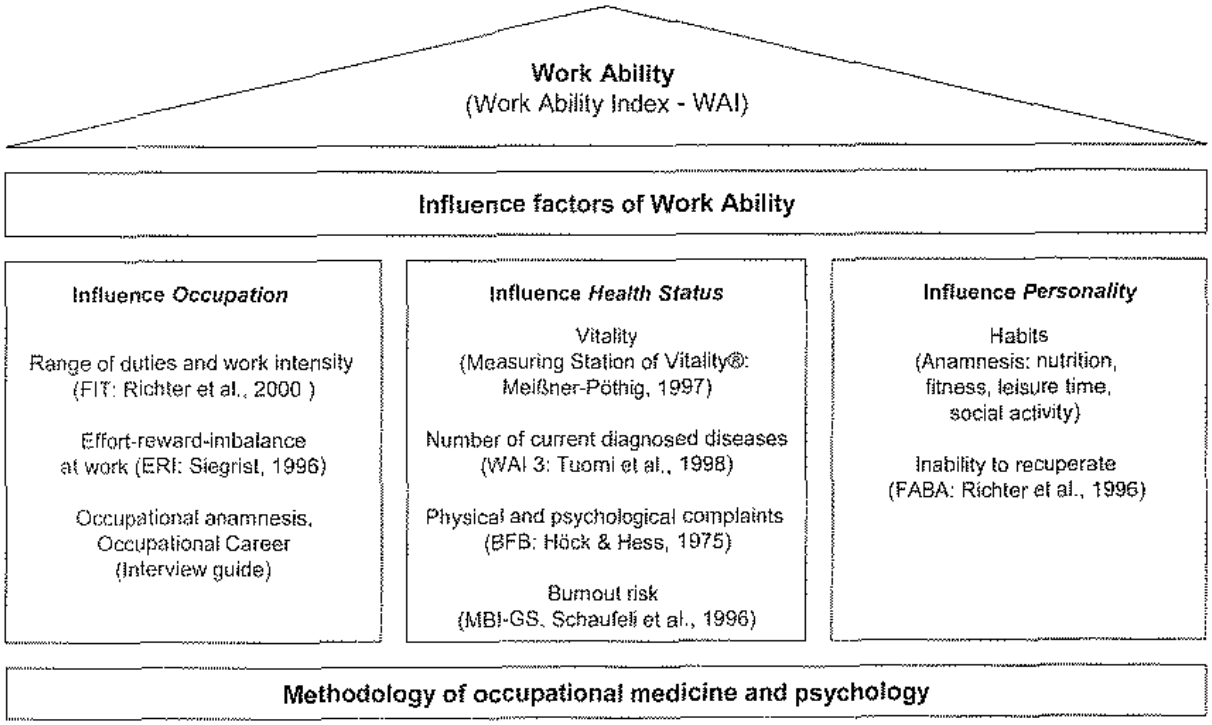

Figure 1: *Methodology for the recording of the work ability and their influential factors.*

Work Ability Index (WAI)

The WAI is based on a self-assessment of work ability and gives information about the individual health state, the physical and mental demands in the occupation and the capacity of performance (Tuomi, Ilmarinen, Jahkola, Katajarinne & Tulkki, 1998). The WAI describes how well an employee is capable to do his job (Tuomi, Ilmarinen, Jahkola, Katajarinne, & Tulkki, 2001). It's recommended as diagnostic instrument for the development of measures for the health-support and to identify employees, who require medical care. The aim is to prevent the premature reduction of work ability. The WAI measures the following seven aspects of work ability:

- current work ability compared with life time best (WAI 1);
- work ability in relation to the physical and mental demands in present work (WAI 2);
- current number of diseases or injuries diagnosed by a doctor (WAI 3 - 51 diseases which are assigned to 14 illness-groups afterwards);
- subjective estimation of work ability impairment due to diseases (WAI 4);
- sick leave taken in the last twelve months (WAI 5);
- personal prediction of work ability in the next two years (WAI 6) and
- psychological attitudes and resources to do the job (WAI 7).

The cumulative index of WAI ranges from 7 to 49 points is divided into the following categories: poor (7 - 27 points), moderate (28 - 36 points), good (37 - 43 points) and excellent work ability (44 - 49 points).

Vitality Measurement Station (Vitalitätsmessplatz®)

Vitality is defined as the age- and gender-corrected functional state and the well-being of the whole organism based on the troika of physical, mental and socio-emotional capabilities of a man (Meißner-Pöthig, 1997). The *vitality measurement station®* (Meißner-Pöthig, 1997) is an inventory for the assessment of the *health status* in accordance with the WHO definition as physical, emotional and social well-being (Figure 1). This diagnostic method is used to identify individual risks and resources which frequently are in relation to the personal habits (e.g. lack of exercise, bad nutritional habits, sensitivity to stress and stress management). The measuring system is a multidimensional test battery comprising 45 vitality indicators to assess the following functions:

- *cardiopulmonary system* (e.g. blood pressure, pulse at-rest and work load, vital capacity, arterial oxygen partial pressure, cardiovascular index after submaximal strain);
- *musculoskeletal system* (e.g. muscular strength, speed, coordination capabilities);
- *sense organs* (e.g. visual/auditory acuity, visual/auditory reaction capabilities);
- *body composition* (e.g. body fat, active cell mass, water ratio, waist hip ratio);
- *psychological and mental dimensions* (e.g. verbal/cognitive response, reorientation capabilities, concentration, flexibility, strategy building, memory capacity);
- *physical and psychological complaints* measured by the BFB-questionnaire (Höck & Hess, 1975) and
- *social factors* (obligations and leisure time, behaviour under stress, social competence).

The age-related changes of the individual vitality indicators are condensed in a *functional age index* (FAI) - an indication of the *vital age*. The calculations of the FAI are based on age- and gender-related reference values for a defined reference population in which the calendrical and biological functional age correspond in normal-aging persons (Meißner-Pöthig, 1997). The vital (biological) aging speed can differ considerably.

Maslach Burnout Inventory - General Survey

Finally, as an indicator of health status the *burnout risk* was measured with the questionnaire Maslach Burnout Inventory - General Survey (MBI-GS: Schaufeli, Leiter, Maslach & Jackson, 1996) developed for use with all occupations other than the human services and educations. The MBI-GS subscales *emotional exhaustion*, *cynicism* and *professional efficiency* ranged in a codomain from 0 to 6. A high degree of burnout is

reflected in high scores on *emotional exhaustion* and *cynicism* and low scores in *professional efficiency*. To evaluate the burnout risk the instruction from Kalimo, Pahkin, Mutanen & Toppinen-Tanner (2003) is used ("no burnout": 0 - 1,49 points, "some burnout symptoms": 1,5 - 3,49 points, "burnout risk": 3,5 - 6 points).

Work-related Factors

Some *occupational factors* were assessed by means of a professional case history (self-made structured interview). The participations were asked for example to their working conditions and occupational career.

For measuring the range of *job demands* (JD) and *decision latitude* (DL) the FIT questionnaire (Richter, Hemmann, Merboth, Fritz, Hänsgen & Rudolph, 2000) was used. It is a screening instrument for the assessment of the coherence between the working situation and the consequences of work. In the result of the questionnaire an occupation can be classified as *active* (high JD and DL), *low strain* (low JD and high DL), *passive* (low JD and DL) or *high strain job* (high JD and low DL). *High strain jobs* should be connected with an increased risk for cardiovascular diseases (Kivimäki, Leino-Arjas, Luukkonen, Riihimäki, Vahtera & Kirjonen, 2002).

The *effort-reward-imbalance* at work was measured by the short version of ERI questionnaire with 23 items (Siegrist, Starke, Chandola, Godin, Marmot, Niedhammer & Peter, 2004; Siegrist, 1996). It is applied to identify chronic effects of psychomental and sozioemotional stress and to estimate associated health hazards. The subscale occupational *reward* measures satisfaction with a three-factorial structure: financial and status related aspects (1), esteem rewards (2) and gratification of job security (3). If the ratio between effort and reward at work is higher than 1 (high effort and low gratification) a healthy risk can be expected.

Factors of Personality

Determined *anamnestic factors and habits* (e.g. age, marital status, current complaints, smoking, consumption of alcohol, unfavourable nutritional behaviour, behaviour at leisure time) were assessed by means of a self-made structured interview.
The *inability to relax* was examined by using the corresponding subscale from the standardized questionnaire FABA (Richter, Rudolf & Schmidt, 1996). This subscale gives an information for risk assessment of inefficient coping with demands and disturbed relaxation. The codomain of the score for relaxation inability ranges from 6 to 24. The general cut off for "noticeable" values is 19 and for "very noticeable" values 21.

Results

Comparison among Occupational Groups

The *work ability* of teachers with an average of 39 ± 6 points is significantly lower than the work ability of office workers with an average of 41 ± 5 points ($p = .001$). More teachers than office workers show a poor or moderate (37 vs. 18%) work ability. Good

work ability is almost evenly distributed in both occupational groups (50 vs. 53%) but excellent work ability can be found twice as often among office workers than in teachers (13 vs. 28%).

Health risk factors and *resources* of work ability included in the analysis were diagnosed diseases, current complaints, relaxing capacities, burnout risk and the ratio of effort and re-ward at work but also cardiovascular risk factors (e.g. body mass index - BMI, waist hip ratio - WHR, pulse performance index - PPI), physical and mental 'fitness' and vital age.

The occupational groups do not differ regarding the number of *physical and psychic complaints.* That means that teachers don't have more complaints than office workers. However, 68 % of the teachers and 60 % of the office workers report about exhaustion as their most frequent complaint. On average, six physical complaints are reported in both groups (teachers: 6.3 ± 4.6; office workers: 6.4 ± 4.7; p = .901). From the mental area 2.3 ± 2.5 (teachers) and 2.6 ± 2.8 (office workers) complaints are declared (p = .513).

Moreover, the *frequency of risk factors for cardiovascular diseases* of teachers is lower compared with office workers (Table 2). High blood pressure is analyzed in almost every second office worker (OW: 47%; TE: 25%; p = .033) but only approximately 12 percent of them are treated with antihypertensive medication (Table 2). More than a third of office workers (37%) is overweight but there is no significant effect (p = .199) to teachers (27%). This is reflected in a high proportion of fat in the body composition. In the group of office workers the proportion of body fat is 23 ± 7 kg on average and thus about 3 kg higher than the fat proportion in the group of teachers (normal range: 10 - 17 kg). There is a health risk by the waist hip ratio (WHR - unfavourable fat distribution pattern) for 12% of teachers and 18% of office workers. For the fitness index, the average values of the groups are above the value of 2 which corresponds to a good fitness. The similar composition of the active body cell mass (e.g. muscle mass) indicates a comparable fitness as well.

Table 2: *Selected risk factors for cardiovascular diseases in teachers and office workers. (means and standard deviations; frequencies [%]).*

Analysed risk factors for cardiovascular diseases	Teachers (n = 100)	Office Workers (n = 60)	Significance p-value
Blood pressure			
Systolic blood pressure [mmHg]	125,0 ± 15,3	129,8 ± 13,6	.048
Diastolic blood pressure [mmHg]	80,6 ± 8,6	84,8 ± 9,1	.005
- Hypertension (>140/90 mmHg)[1] [%]	25,0	46,7	.033
- Antihypertensive medication	12,0	11,7	.950
Fitness			
Fitness index (PPI)[2]	2,1 ± 0,8	2,1 ± 0,6	.994
- PPI < 1 (poor) [%]	7	2	.414
- PPI > 2 (good) [%]	50	57	.
Body measures			
Body fat mass [%]	20,4 ± 7,3	22,7 ± 7,2	.086
Active body cell mass [%]	25,2 ± 2,6	25,4 ± 3,1	.195
Body Mass Index (BMI) [kg/m²]	23,7 ± 3,3	24,3 ± 3,8	.299
- Overweight (BMI ≥ 25 kg/m²)[3] [%]	27,0	36,6	.199
Waist Hip Ratio (WHR)	0,79 ± 0,6	0,80 ± 0,5	.440
- Metabolic risk (WHR > 0,85)[3] [%]	12,0	18,3	.272

The *functional age index* (a construction of the measured vitality indicators) which mirrors the vital age, shows that teachers (40.6 ± 8.0 years) compared with their calendrical age (44.6 ± 7.7 years) have a younger vital age, whereas in office workers the vital age (44.5 ± 5.3 years) corresponds to their calendrical age (42.6 ± 8.7 years). This indicates an obviously better vitality status in teachers than office workers. The vital functional age of teachers is strongly affected by their *excellent mental capacities* (e.g. flexibility, concentration, strategy building, memory capacities), a better physical fitness (pulse performance index) and in this way a good training status of their cardiovascular system (resources). Despite the fact that teachers are generally marked by more job-related and everyday job demands and a lower proportion of leisure time than can be assessed for office workers, they use their leisure time actively to keep up their physical fitness and well-being.

Unlike office workers, teachers achieve the significantly highest values for *relaxation inability* (17.1 vs. 3.5 ± 3.8 points; p = .000); 31% have an '*noticeable*' or '*very*

[1] The sixth report of the Joint National Commitee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (1997). Arch Intern Med, 157: 2413-46.

[2] PPI = Pulse Performance Index: Ratio of pulse frequency difference (pulse at work load minus pulse at rest) to duration of work load

[3] Deutsche Adipositas-Gesellschaft, Deutsche Diabetes-Gesellschaft, Deutsche Gesellschaft für Ernährung. Evidenz basierte Leitlinie - Prävention und Therapie der Adipositas (German Adiposity Association, German Diabetes Association, German Association for Nutrition. Evidence based Guideline - Prevention and Therapy of Adiposity)

noticeable' relaxation inability (Table 3), while in office workers only for 7% high values are found (p = .000).

For the total value of the *burnout risk* significant differences result from the occupation. Teachers (1.7 ± 0.7 points) have significantly (p = .000) higher values in burnout risk in comparison to office workers (1.2 ± 0.8 points). A distinctive burnout risk (3.5 points) is available merely in 3% of office workers but more than 50% of teachers. Only approximately a fourth of office workers show burnout symptoms (Table 3). In teachers there is a proportion of emotional exhaustion, which is twice as high as in office workers (34% vs. 17%: p = .000).

Table 3: *Selected personal and work-related risk factors in teachers and office workers. (means and standard deviations; frequencies [%]).*

Analysed parameters	Teachers (n = 100)	Office Workers (n = 60)	Significance p-values
Relaxation inability (6 – 24 points)			
Total sum [points]	17,1 ± 3,7	13,5 ± 3,8	.000
- noticeable sum (19 – 24 points) [%][4]	31	7	.001
Burnout risk (0 – 6 points)			
Total score (weighted) [points]	1,7 ± 0,7	1,2 ± 0,8	.000
- Single symptoms (1,50 – 3,49 points) [%][5]	58	22	.000
- Total burnout (≥ 3,50 points) [%][5]	0	3	
Work-related effort- reward-ratio			
Effort (6 - 30 points)[6]	17,1 ± 4,3	14,7 ± 3,6	.000
Reward (11 - 55 points)[6]	48,6 ± 5,1	47,5 ± 6,3	.378
Effort-reward-imbalance (ERI)	0,65 ± 0,2	0,56 ± 0,2	.008
- Health risk (≥ 1) [%][6]	7	0	.036

Furthermore, significant differences between the occupations in range of *job demands* and *decision latitude* could be determined. Teachers differ from office workers by a bigger range of job demands (teachers: 3.3 ± 0.3; office workers: 3.1 ± 0.5; p = .010) and a higher decision latitude (teachers: 3.1 ± 0.5; office workers: 2.8 ± 0.6; p = .001). According to the classification of Karasek (Karasek, 1979; Karasek & Theorell, 1990) 90% of teachers can be found in an *active job* and 10% in a *low strain job*. The distribution of the office workers varies more strongly. The office workers can be classified to all categories except the *passive job* (active job: 65%, low strain job: 27%, high strain job: 8%).

[4] Classification of the recuperation incompetence from Richter, Rudolf & Schmidt (1996)
[5] Assessment rule and classification of the burnout risk from Kalimo et al. (2003)
[6] Assignment rule and classification of the effort reward imbalance from Siegrist (1996)

Despite inferior difference, teachers (0.7) report a significantly ($p = .008$) stronger *effort-reward-imbalance* than office workers (0.6). This more unfavourable effort-reward-imbalance in the group of teachers result from the effect that teachers tend to overexert more strongly in their occupation than office workers but teachers get a comparable recognition from the occupational field (Table 3). However, the ERI mean values classified are quite safe. There is a health risk for only 7% of teachers (office workers: 0%; $p = .036$).

Predictors of Work Ability

In order to find *predictors* of the work ability a *CHAID analyses* were carried out. CHAID (chi-squared automatic interaction detector) was developed by Kass (1980) for nominal and extended to ordinal dependent variables by Magidson (1994). These analyses are used to build a predictive model, based on a classification system. CHAID modelling selects a set of predictors and their interactions that optimally predict the criterion (dependent) variable (here work ability). The analysis subdivides the sample into a series of subgroups that share similar characteristics towards a criterion variable (work ability), and that maximises our ability to predict the values of this variable. The classic CHAID algorithms can accommodate both continuous and categorical predictors. The first predictor category (on which the sample will be split) is the predictor that is associated the most with the criterion (dependent) variable (i.e. it gives the most differentiating groups of respondents). Each group is then further split until the analysis does not find any significantly discriminating predictor any more. The predictor with the lowest significance value ($p < .05$ or $p < .001$) is the best. The developed model is a classification tree (tree-diagram) that shows how major "types" formed from the independent variables differentially predict the criterion variable. Based on significant predictors future work ability is forecast (Figure 2).

Work-related and health risk factors as well as resources of work ability were included in CHAID analysis: the current complaints, relaxation capacities, burnout risk and the effort-reward-ratio at work but also cardiovascular risk factors (BMI, WHR, PPI), physical and mental 'fitness' and the vital functional age.

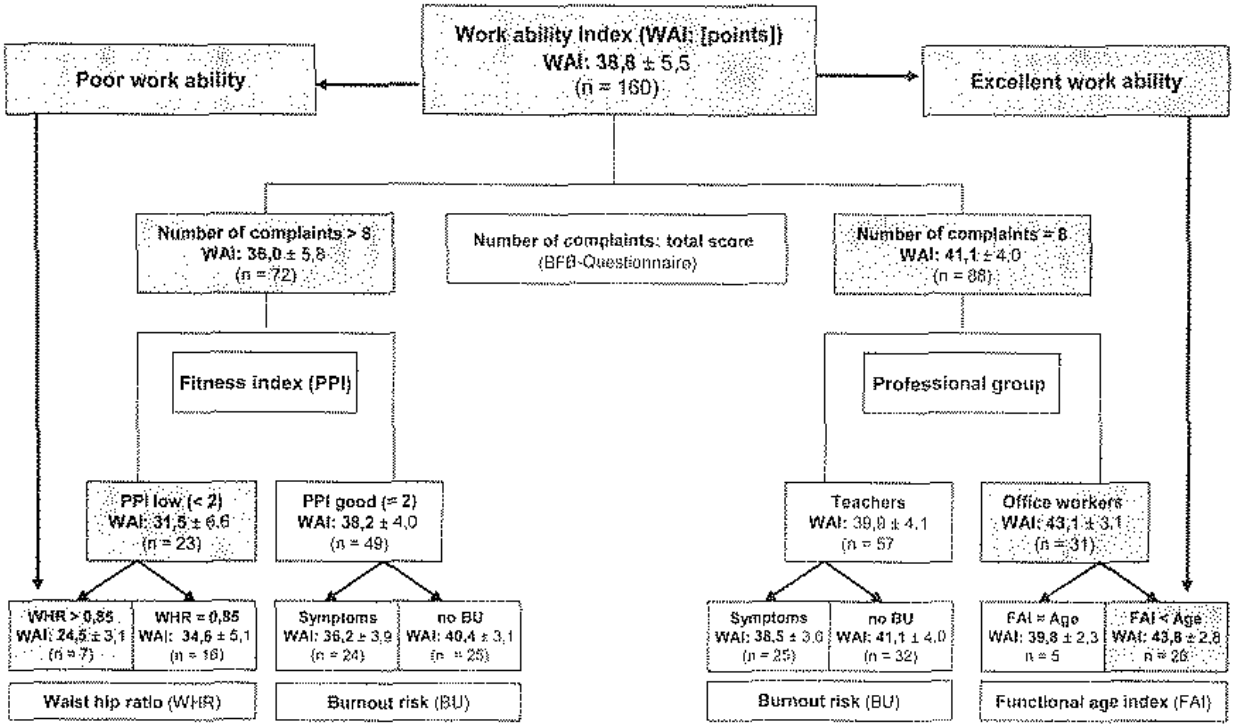

Figure 2: *CHAID-Analysis (SPSS Answer Tree) - Predictors of poor or excellent work ability for teachers (n =100) and office workers (n = 60).*

According to this analysis the main *influencing factors* on work ability are the following: Physical and mental complaints (BFB-questionnaire: p = .000), fitness index (PPI: p = .000), occupational group (p = .003), waist hip ratio (WHR: p = .001), classified burnout risk (p = .001 and p = .013), and vital functional age (FAI: p = .042). *Impaired* (poor) *work ability* is mainly associated with an increased number of physical and mental complaints (BFB-questionnaire), a moderate fitness status of the cardiovascular system and an unfavourable classification of the waist hip ratio. By contrast *excellent work ability* is associated with few physical and mental complaints (BFB-questionnaire), the occupation "office workers", a younger vital functional age and the absence of burnout symptoms. The number of complaints seems to be the strongest factor in both groups for an impaired work ability (teachers: r = .65; office workers: r = .73).

Summarizing these findings *poor work ability* can be found in both occupational groups. It's especially related to physical risk factors. *Excellent work ability* can be found among teachers with high mental resources and among office workers with young vital functional age. After all 43% of office workers show excellent work ability (WAI: 44 ± 3 points). According to these predictors teachers do only achieve such good work ability. However, this is true for more than half of the assessed teachers (57%). Calendrical age doesn't prove to be a predictor of work ability in both groups. Women who work in psychologically demanding occupations show poor work ability, especially if a variety of complaints is combined with an unfavourable waist hip ratio (WAI: 24 ± 3 points). This CHAID-analysis is able to explain 61.2% of the variance of work ability.

Discussion

Comparison of Occupational Groups

In general, teachers differ from office workers in terms of more unfavourable effort-reward-imbalance (ERI) and higher proportion of emotional exhaustion and cynicism (MBI-GS). More than 58% of teachers but only 25% of office workers show burnout symptoms as a result of job-related strain ($p = .000$). However in no case a full burnout syndrome could be diagnosed. In addition, teachers have higher relaxing capacities than office workers (FABA: sum score > 17 points). Especially the combination of high exhaustion and a higher level of relaxation inability are threatening to people's health as their free-time doesn't offer enough recreation after a working day.

The permanent state of imbalance between efforts made at work and reward gained can lead to stress reactions (e.g. stress or activations of the central nervous system) which have to be considered as health risks. This effort-reward-imbalance has to be regarded as an additional health risk in 7% of teachers. Admittedly there is a discrepancy between teacher's subjective estimation of work ability and their vitality status. A significantly lower work ability among teachers than among office workers can be assessed, although their vital functional age index is much younger compared to office workers. This indicates a different speed of aging among teachers and office workers but also a connection to education and occupational demands. This range illustrates once more that the speed of aging – independent of the occupational group – can vary considerably in each individual case (different '*vitality patterns*').

The results of health status (vitality) reflect the effects of work-related demands and an unhealthy lifestyle. But they also indicate resources for the preservation of the work ability. The vital functional age of teachers, for instance, is strongly influenced by mental performance capabilities and physical fitness. These factors promote the ability to cope with occupational demands.

'High' education has positive effects on preservation of nearly all performance features. In addition to the high education level, the continuous training of mental capacities, as it is characteristic for grammar school teachers, is beneficial to the preservation of the high mental performance capacities. This is because functions which are frequently used remain at a high level for a long time ("use hypothesis"). This is not only true for the training of physical capacities but also for mental and social capabilities. There is an occupational transfer effect assumed. The high level of work-related mental demands in teachers allows to transfer these effects on other non-occupational abilities (Welford, 1976). According to Staufer (1992) teachers are more sensitive to changes (e.g. weakness of memory) than other occupational groups.

Predictors of Work Ability

In both groups impaired work ability is closely related to a high number of physical and mental complaints and physical risk factors (PPI, WHR). Excellent work ability among teachers is mainly marked by mental resources (no burnout risk), whereas it's characterized by a young vital functional age (FAI) among office workers. In comparison

with office workers the teachers have a 1.6 times higher risk for impaired work ability (WAI < 37 points).

In order to identify relevant risk factors and resources in both occupational groups an integrated occupational medical and psychological research method has proved useful (Figure 1), as health risks and resources at work are multidimensional. However, it's only one sphere of influence of work ability. In order to find other reasons for impaired work ability, more factors have to be taken into account – especially vitality but also individual habits (diet, fitness, leisure time) and personal coping capabilities like recreational capacities, burnout risk, stress management as well as effort and reward on the job (Mearns & Cain, 2003; Gaziel, 1993). The assessment of different vitality functions in particular allows a focused intervention which considers the individual lifestyle. If the prognostic significance of WAI for the occurrence of occupational disabilities is taken into account, it can be concluded – considering the described risk factors – that teachers are more likely to retire early from their job due to health reasons.

Summarizing it can be said that long-lasting work ability requires long health. Preventive measures are necessary to protect and promote employees' health. To sustain and promote work ability not only work-related risks but also lifestyle, health behaviour (e.g. diet, stress prevention) and individual resources should be focused. Depending on the individual diagnosis it's possible to recommend certain training methods and programmes of sports medicine, instructions for stress and life problem management.

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