RELATIONSHIP BETWEEN WORK ABILITY AND OXIDATIVE STRESS

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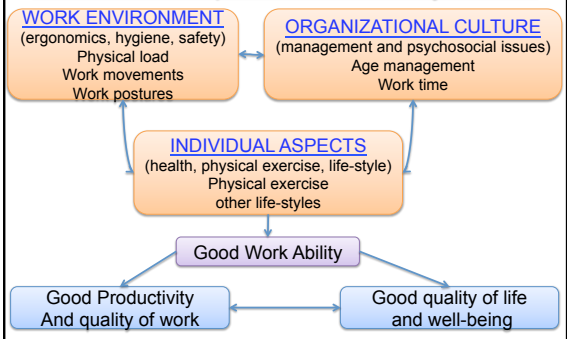
Introduction

- **Work ability** is a complex concept that is determined by several factors, including age and physical and mental fitness (Ilmarinen, et al., 1993).
- **The Work Ability Index (WAI)**, which was developed by the Finnish Institute of Occupational Health (FIOH), is often used for the estimation of work ability.
  - Good work ability is associated with a good quality of work and life.
  - The work ability is improved by an increase in the vigorous leisure-time physical exercise (Tuomi, et al., 1997).
- Oxidative stress is detected before occurrence of clinically significant diseases as well as mental disorders.
- However, no study has investigated the association between work ability and markers of oxidative stress.

Concept of Work Ability



(Ilmarinen et al., 1993)

Work Ability Index (WAI) questionnaire items

Item	For short	Scale
1. Subjective estimation of present work ability compared with lifetime best.	(Current work ability)	0-10
2. Subjective work ability in relation to both physical and mental demands of the work	(Work ability for job demands)	2-10
3. Number of diagnosed diseases	(Diagnosed diseases)	1-7
4. Subjective estimation of work impairment due to diseases	(Work impairment)	1-6
5. Sickness absenteeism during the past year	(Absences)	1-5
6. Own prognosis of work ability after 2 years	(Prognosis of work ability)	1, 4, 7
7. Psychological resources (enjoying daily tasks, activity and life spirit, optimistic about the future)	(Mental resources)	1-4

Higher scores indicate better work ability.

(Sörensen, et al., Applied Ergonomics 2008; 39: 786-791, Smolander, et al., JOEM 2000; 42: 906)

Classification and Follow-up of WAI

Points	Work Ability	Objective of Measures
7-27	Poor	Restore work ability
28-36	Moderate	Improve work ability
37-43	Good	Support work ability
44-49	Excellent	Maintain work ability

(Ilmarinen and Tuomi et al., Work Ability Index, 1998)

Aim

The aim of this study is

to elucidate the association
between **Work Ability** and **Oxidative Stress**
using data from an intervention study
with a lifestyle modification program.

Methods

- **Participants**: 19 workers
  (participated in a community-based lifestyle modification program)
- **A lifestyle modification program**
  Aerobic exercise
  Diet counseling
  12 weeks

- **Measurements**
  (1) Work Ability: WAI
  (2) CV risk factors: body mass index (BMI, waist)
  blood pressure (SBP, DBP)
  glucose metabolism (FPI, FPG, HbA1c, HOMA-IR)
  lipid metabolism (HDL-C, TC, TG, TC/HDL-C ratio, LDL-C)
  cardiopulmonary endurance ($\dot{V}O_2$max)
  (3) Markers of oxidative stress:
  Superoxide dismutase (SOD) activity
  urinary 8-iso-prostaglandin $F_{2\alpha}$ ($PGF_{2\alpha}$)
  $PGF_{2\alpha}$/SOD ratio (Oxidative stress index)

Result 1. Characteristics of participants

	mean SD
CV risk factors	
age, years old	55.6± 7.7
Sex, male %	9/10, 47%
BMI	22.8± 3.3
Waist, cm	84.3± 7.3
SBP, mmHg	131.4± 17.9
DBP, mmHg	76.6± 11.8
PR, /min	75.9± 8.2
$\dot{V}O_2$max, ml/kg/min	32.5± 5.1
FPI, μU/ml	5.6± 2.7
FPG, mg/dl	101.7± 11.0
HbA1c, %	5.3± 0.4
HOMA-IR	1.42± 0.79
HDL-C, mg/dl	65.2± 12.9
TC, mg/dl	217.1± 37.2
TG, mg/dl	123.2± 70.2
TC/HDL ratio	3.40± 0.58
LDL-C, mg/dl	120.5± 27.5
Index for Oxidative stress	
$PGF_{2\alpha}$, μg/gCre	1.8± 0.7
SOD activity (U/ml)	14.4± 5.2
$PGF_{2\alpha}$/SOD	0.15± 0.08

<Abbreviation>
CV: cardiovascular
BMI: body mass index
SBP: systolic blood pressure
DBP: diastolic blood pressure
PR: pulse rate
FPI: fasting plasma insulin
FPG: fasting plasma glucose
HOMA-IR: Homeostasis model assessment-Insulin Resistance
HDL-C: high density lipoprotein cholesterol
TC: total cholesterol
TG: triglyceride
LDL-C: low density lipoprotein cholesterol
$PGF_{2\alpha}$: 8-iso-prostaglandin $F_{2\alpha}$
SOD: superoxide dismutase

Result 2. Scores of WAI and each item

Variables	Range of score	Mean SD
WAI score	7 - 49	40.7± 3.4
Scores of each item		
Current work ability	0 - 10	7.4± 1.6
Work ability for job demands	2 - 10	7.9± 1.5
Diagnosed diseases	1 - 7	5.4± 1.8
Work impairment	1 - 6	5.8± 0.5
Absences	1 - 5	4.6± 0.6
Prognosis of work ability	1, 4, 7	6.5± 1.1
Mental resources	1 - 4	3.0± 0.7

Classification	N	%
EXCELLENT	4	21.1
GOOD	12	63.2
MODERATE	3	15.8

Result 3. Relationships between WAI and Oxidative Stress

Variables	$PGF_{2\alpha}$ r	$PGF_{2\alpha}$ p	SOD r	SOD p	$PGF_{2\alpha}$/SOD r	$PGF_{2\alpha}$/SOD p
WAI score	-0.402	0.088	-0.106	0.665	-0.213	0.380
Each item						
Current work ability	-0.340	0.155	0.292	0.226	-0.357	0.134
Work ability for job demands	-0.319	0.183	0.083	0.736	-0.327	0.172
Diagnosed diseases	0.064	0.796	-0.438	0.061	0.292	0.225
Work impairment	0.140	0.568	-0.607	0.006	0.309	0.197
Absences	0.173	0.478	0.009	0.970	0.181	0.457
Prognosis of work ability	-0.265	0.273	0.090	0.714	-0.144	0.555
Mental resources	-0.487	0.035	0.055	0.822	-0.423	0.071

Result 4. Effects of intervention on CV risk factors

Changes by intervention	mean±SD	p value
ΔBMI	-0.41± 0.48	0.002
ΔWaist	-1.54± 3.00	0.038
ΔSBP	-18.47± 12.14	<0.0001
ΔDBP	-9.84± 8.54	<0.0001
Δ$\dot{V}O_2$max	1.16± 2.34	0.044
ΔFPI	0.46± 2.16	0.364
ΔFPG	-0.37± 9.10	0.862
ΔHbA1c	-0.02± 0.12	0.448
ΔHOMA	0.10± 0.67	0.537
ΔHDL-C	0.63± 7.37	0.713
ΔTC	-8.95± 26.59	0.160
ΔTG	-27.68± 47.36	0.020
ΔTC/HCL-C ratio	-0.16± 0.27	0.024
ΔLDL-C	-2.00± 18.09	0.636
Δ$PGF_{2\alpha}$	-0.02± 0.61	0.906
ΔSOD	2.56± 4.80	0.032
Δ$PGF_{2\alpha}$/SOD	-0.02± 0.07	0.191

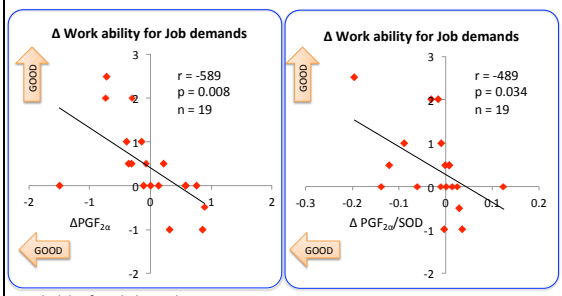
Result 5. Effects of intervention on WAI

Changes in variables	Mean±SD	p value
ΔWAI	-0.21± 2.31	0.965
Each item		
Δ Current work ability	-0.11± 1.45	0.755
Δ Work ability for job demands	0.42± 0.95	0.069
Δ Diagnosed diseases	-0.05± 1.58	0.886
Δ Work impairment	-0.05± 0.40	0.578
Δ Absences	0.00± 0.75	1.000
Δ Prognosis of work ability	0.00± 1.00	1.000
Δ Mental resources	-0.42± 0.51	0.002

Result 6-1. Relationship between changes in WAI and in Oxidative Stress

Changes in variables	ΔPGF$_{2\alpha}$ r	ΔPGF$_{2\alpha}$ p	ΔSOD r	ΔSOD p	ΔPGF$_{2\alpha}$/SOD r	ΔPGF$_{2\alpha}$/SOD p
ΔWAI score	-0.137	0.576	-0.040	0.872	-0.146	0.551
Each item						
Δ Current work ability	0.118	0.632	-0.145	0.553	0.118	0.631
Δ Work ability for job demands	-0.589	0.008	-0.089	0.718	-0.489	0.034
Δ Diagnosed diseases	0.136	0.578	0.155	0.526	0.034	0.891
Δ Work impairment	-0.109	0.656	-0.176	0.472	-0.022	0.930
Δ Absences	-0.278	0.250	-0.311	0.195	-0.021	0.931
Δ Prognosis of work ability	0.044	0.859	0.090	0.713	-0.019	0.939
Δ Mental resources	0.126	0.607	0.336	0.160	-0.105	0.669

Result 6-2. Relationship between changes in WAI and in Oxidative Stress



Work ability for Job demands:
Subjective work ability in relation to both physical and mental demands of the work

Summary

1. **The association between work ability and oxidative stress (Result 3)**
   - The WAI score and PGF$_{2\alpha}$ were negatively correlated at baseline.
   - Among the WAI items, the urine levels of PGF$_{2\alpha}$ and oxidative stress index (PGF$_{2\alpha}$/SOD ratio) showed significant negative correlation with mental resources.
   - The plasma SOD activity also showed significant negative correlation with number of diagnosed diseases and work impairment.
2. **The effects of the lifestyle modification (Result 4,5)**
   - CV risk factors including BMI, blood pressure, physical endurance, and lipid profiles were improved by the intervention.
   - Plasma SOD activity was significantly increased.
   - The WAI score was unchanged by lifestyle modification, whereas the score of WORK ABILITY FOR JOB DEMANDS was improved.
3. **The changes in parameters (Result 6)**
   - The reductions in PGF$_{2\alpha}$ and oxidative stress index (PGF$_{2\alpha}$/SOD ratio) showed significant correlation with the improvement in work ability for job demands.

Conclusion

Oxidative stress is associated with the work ability;

this suggests that oxidative stress is a good indicator of work ability.