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Olavi Manninen

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Opening Address

Dear Ladies and Gentlemen,

Combinations of and interactions between environmental factors are constantly producing actual challenges from the point of view of both in basic and in applied research. The combined actions and combined effects of different environmental factors and the study of these effects are among the most central and problematic questions in the field of traditional medicine, pharmacology, occupational health, public health, environmental health, labor protection, industrial hygiene, toxicology, ergonomics, environmental planning, business, health economics, meteorology, standardization, machine construction and statistics.

On 22-25 September 1984 The First International Conference on Combined Effects of Environmental Factors was held in Tampere, Finland. It was my deep wish and great honor to act as convener of conference. The idea to create a warm, stimulating international forum for regular contacts between researchers like this had grew up in my mind for years.

During the last day of the conference, on 25 September 1984, a new international scientific organization was established to further research on the complex combined effects of environmental factors and to ensure continuing contact between researchers working in this field. The International Society for Complex Environmental Studies – ISCES society – came out. Consequently, the very first ICCEF Conference marked the beginning of a new international cooperation. Since those days whole bunch of international scientific events have been arranged. The next ever remembering meetings were held in Kanazawa (Japan) in 1986, in 1988 in Tampere, in 1990 in Baltimore (USA), in 1992 in Saariselkä (Finnish Lapland), in 994 in Toyama (Japan), in 1996 in Tampere, in 1998 in Baden (Wien, Austria), in 2000 in Savonlinna (Finland) and in 2002 in Takatsuki (Japan).

During those meetings the combined actions and combined effects of environmental factors have been examined from several different perspectives. In addition to this today we can recognize that, not only us, but many other scientific organization are arranging special sessions or satellite meetings which are focusing on the interactions between or combined effect between the factors. Without boasting I feel that we have been pioneers in the field and even pushed the other to pay more attention to this ever actual complex issue.

With regard to this, many excellent presentations have been given and numerous qualified papers have been edited and published. First of all, the events have brought the researchers in the field together, but, unfortunately, also separated them from us. For the run of the past 25 years many skilled and world-famous colleagues have retired or even died. In this sense I am deeply delighted when seeing you both my old and new friends here. So far I would like to express my sincere appreciation to you all in joining this thematic meeting on work life ability ICCEF 2007 conference. You are heartily welcome!

Olavi Manninen
Chairman of The ICCEF 2007 Conference
President of The International ISCES-Society
Welcome Address

Dear Ladies and Gentlemen,
Mr. Chairman,

Tampere is the birthplace of Finnish industry. We, the residents of Tampere, have every reason to be proud of our crib of industrialisation in Finland. Walking on the banks of the Tammerkoski rapids traversing the town you can still see how the town evolved into a pioneer of Finnish textile, engineering and wood processing industry.

For example, Finland’s first paper mill started production in 1783, Finland’s first large-scale industrial enterprise, the Finlayson cotton mill, was founded in 1820, Finland’s first paper machine started production in 1842, the first electric light in the Nordic countries was lit in the Finlayson factory in 1882. At the beginning of the 20th century, Tampere was Finland’s leading industrial city. Tampere is still the centre of Finnish industry.

Today, the red-brick factories, the former workplaces of the cotton-mill girls, ironworkers and pulp mill workers provide a home for new enterprises and services. During Finnish industrial development, the Tampella area was known for producing turbines, ships and locomotives. Today, this versatile Vapriikki Museum Centre is located in a genuine historical industrial milieu at the former Tampella engineering workshop.

According to latest image studies Tampere is the most attractive place to live, work and study in Finland. The TAMK University of Applied Sciences, in turn, is the most attractive and popular university, which I as a University Board member am of course delighted to note. For this reason it brings me great pleasure to have this opportunity to wish you all welcome in this ICCEF 2007 Conference. This Conference addresses many issues that are very topical from the perspective of the development of work life. They are also very central in terms of the future development of education and research of work life ability at our university.

I wish good luck and fruitful discussions to the conference on combined actions and combined effects of environmental factors.

You are heartily welcome to Tampere, the largest inland town in Scandinavia and the most popular town with many world – first high – tech innovations.

Reino Kanerva
Government Counselor
Member of The Board, TAMK University of Applied Sciences, Tampere
DIVERSITY—CHANCE OR CHALLENGE TO EUROPEAN FIRMS?

Katrin Hansen

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Abstract

“Diversity Management” has been and still is an issue in the USA since the beginning of the 90ts. Recently this discussion gains momentum in European corporations, too. The reason is that managers discover “Diversity Management” as a chance to cope effectively with internal and external changes and to make a better use of the individuals’ work-life-abilities. Experiences from German firms show that the US-American way of managing diversity has to be modified to meet European needs. Based on the analysis of international literature, recently conducted research is reported and compared to results of own empirical research (interviews in German corporations and institutions of higher education), and options for dealing with diversity are discussed. The focus is on gender and culture as diversity dimensions with high relevance to German and European organisations, thereby paying specific attention to the concept of “fault lines”. Chances as well as threats of a diverse work force are discussed. A framework for actions is presented that enables organisations to dealing with “Diversity” by developing a systematic “Diversity Management”. This holistic approach is seen as a requirement for effectively coping with “Diversity” and transforming it from a challenge into a chance.


Key words: Diversity – Diversity Management – Human Resources Management – Stereotypes

Introduction - Understanding the Character of Diversity

“Diversity refers to any mixture of items characterized by differences and similarities” (Thomas 1996). However, it should not be reduced to the level of individual persons. Instead, the occurrence of “fault lines”, based on salient attributes of group members, show the importance of demographics: “When groups newly form, members may use salient demographics to implicitly categorize themselves into subgroups. … Consequently, demographic dissimilarity may engender less interpersonal attraction and less group cohesiveness.” (Lau and Murnighan 1998). Thus, demographics producing “fault lines” may lead to conflict and reduce group performance (Lau and Murnighan 2005, Joshi 2006; see also Li and Hambrick 2005). On the other hand, demographics can be related to stereotypes, thereby producing “stereotype threat” in members of the negatively affected identity groups which lead to reduced task performance on the individual level (Roberson and Kulik 2007). This point of view fits well with a system’s approach, seeing teams as embedded in organizations which, themselves, are embedded in larger societal systems. Thus, structure and principles of the larger system (e.g. power, status and stereotypes related to identity groups) will influence processes in the embedded subsystems (Joshi 2006, Roberson and Kulik 2007).

If diversity management is to succeed, it needs to address identity groups and take account of power structures in both society and in the organizations themselves. Scientific literature on
diversity is paying increasing attention to the power aspect: "There is much theoretical and empirical support for the notion that paying attention to differences in power and status is critical for understanding diversity in organizations" (Ely and Thomas 2001:231, see also Prasad, Pringle, Konrad 2006, Litvin 2006). Those insights highlight the diversity dimension of gender, whose hierarchical asymmetries have been analysed worldwide, As Benshop (2006:290) sums up: “What is clear is that our understanding of gender and organizations does not begin at the door of the office or factory. Work and living are interrelated. … Individual motivations and ambitions are informed by societal expectations, perceptions of socio-structural situations and organizational opportunities.”

Paradigms of Diversity Management

Ely and Thomas (2001) conclude from case studies that an organization's attitude toward diversity and minorities is an extremely decisive variable in making diversity management a success. The attitude of organizations toward diversity can be structured according to the following three paradigms of diversity management. Each of these paradigms can have specific consequences including ones for relations between the genders (see Ely and Thomas 2001, Hansen 2002, Koall 2002, Thomas and Ely 1996).

The “fairness and discrimination” approach

This approach identifies areas of potential discrimination, names them, and subjects them to conflict management. The approach can be motivated by legislative framing conditions and social demands with which organizations comply for either ethical or strategic reasons. As Süß (2007) shows dominant motives for diversity management in German corporations are following those lines: imports from abroad (especially in global firms initiated by US actors) and societal expectations are seen as most influential. Ivanova and Hauke come to similar results with anti-discrimination being ranked second of the advantages related to diversity in international firms in Germany (2006). In those cases diversity is policy very often molded by the American model and probably not woven into the fabric of the German organization.

In the fairness and discrimination approach, members of racial or cultural minorities, and also women, are represented in the company by a politically correct quota or through admittance to certain areas. However, they are not really integrated. The well-known "glass ceiling" is a statistically confirmed effect in German companies, as a strong pressure to assimilate imposed on persons in minority groups as long as a company operates within the framework of the fairness and discrimination approach (see Kanter 1993, Linnehan and Konrad 1999). Schwartz (1993, p. 30, translated) talks about a "subversive impact on women" that leads them to walk away in despair from organizations that are only superficially pro-women (see also Roberson and Kulik 2007).

1 It has to be pointed out that gender is not interpreted as a two-uniform-group phenomenon. Instead, we follow Benshop in her “call for examination of the multiplicity of gendered identities” (2006, p. 291) and Hearn and Collinson: “The focus on multiple masculinities helps in examining the shifting nature of asymmetrical power relations not only between men and women, but also between men in workplaces. Gendered power relations can simultaneously both change yet remain broadly the same.”

2 Nevertheless, there are German firms as well implementing diversity management activities (Süß 2007). In the third chapter we will discuss those approaches further.
Recently, a new phenomenon has been described: The “glass cliff” can even be based on (“benevolent sexism” [...]”, whereby women are assigned (and rewarded for taking on) roles that can be represented as attractive (e.g. as ‘challenging’) but are actually problematic” (Ryan and Haslam 2007). The authors report that those positions are characterized by less authority and fewer tangible rewards; they are more restrictive and less satisfying, leading in sum to more stress.

"Subversive" gender relations can still be found in the organization of German labor and education despite formal equality. They also impact on the situation of pro-women members of the dominant group (Müller 2002).

A company following the F & D-Approach does not really open itself up to new ideas and actions; it loses its potential bearers of change, thereby squandering valuable learning opportunities. Nonetheless, the admittance of minorities to inside posts, the implementation of externally presentable programs, and the enforcement of a "politically correct" regime still have to be seen as a positive effect. They can serve as a first step, even though they cannot result in any general satisfaction, because the hierarchy of gender relations remains untouched. Equal rights are not really anchored in the organization and also cannot become part of its organizational culture. One has to anticipate that members of the dominant groups will engage in repeated outbreaks of resistance. In the worst case, a façade is carefully maintained but crumbles repeatedly because covert discrimination can only continue to be disguised through great effort.

The veiling of power structures in the fairness and discrimination paradigm along with the frequently found "color-blind ideology" (Ely and Thomas 2001, see also Prasad, Pringle and Konrad 2006) send ambiguous signals to members of minority groups: On the one hand, their employment is presented as unproblematic; on the other hand, adaptation is demanded more or less subtly, and failure to achieve this is forgiven generously - but, in truth, condescendingly: "... blacks were to be forgiven for their deviations from (white cultural) norms of acceptable behavior, as these deviations were merely understandable reactions to the unjust circumstances of their lives" (Ely and Thomas 2001). We believe that those research findings from the United States generalize directly to gender relations in Germany.
The "access and legitimacy" approach

The second paradigm for dealing with HR diversity has grown out of a market-oriented perspective. It does not try to mirror socio-demographics but a specific market-dependent demographic feature. The basic idea in development, production, and marketing is to develop key competencies and to secure market shares by employing personnel who are close to one's customers or even the same as them on individual dimensions. Features of employees should mirror those of customers. Either this "fit" should lead employees to develop suitable ideas for opening up and successfully exploiting the market, or it is anticipated that social proximity in customer contact will be a success factor. We found this customer-mirroring approach in our interviews, although addressing other dimensions than gender:

They [the customers] also view themselves in very different ways. And then, everything is still so very strongly . . . traditional that you have people from the caring professions, people from the medical services, and people from administration. And I think that in this . . . branch . . . there are many, very many different kinds of "customer." You can only respond to their needs if you have a correspondingly similar staff: employees who also have many, very different qualifications (consultancy firm).

An international transport company became aware that diversity follows the same path as their company strategy: "It's exactly the same. Fits absolutely . . . our customers and staff and shareholders are diverse, and our market is also diverse, and society as well, of course" (V). As Dippel (2007) shows, parallel thoughts and arguments are valid for public administration especially in connection with culture and language.

From a gender perspective, it is necessary to examine whether it is realistic to assume that women prefer to deal with female business partners, or whether this requires specific framing conditions. Discussions on the purchasing behavior of college students in our own diversity seminars have shown that although this does seem to apply in fields related to one's own body, it does not apply in general. New approaches to marketing that view consumers as co-producers could, on the one hand, turn demographic closeness between customers and service providers into an advantage. However, on the other hand, it could also lead customers themselves to contribute the group perspective, therefore making a mirroring within the company superfluous for marketing. Further empirical research is needed on these issues.

Another problem with the access and legitimacy approach is that it positively invites stereotyping, because employees are reduced to their membership of a certain social group, and typical group attitudes and behaviors are anticipated or encouraged. This either ignores or denies the diversity to be found in individuals, their many-faceted personalities, and their different roles and functions. Finally, one has to ask what happens to persons whose value for the company is due basically to their membership of a social group when that specific market segment becomes less important (loss of purchasing power, shifts on the market). They are not really accepted in this approach, but merely functionalized. At the same time, they have to bear unique responsibility for satisfying the needs of the customers in the group to which they are assigned. The organization can shirk off its own responsibility, and learning is also only limited. This makes it doubtful whether this concept will have any lasting practicality.

Gebert (2004) states that diversity has to deal with a dilemma: "Resources related to diversity do not automatically blaze the trail as intended." Social categorization, conflicts on the level of relations and, what is even more dangerous, conflicts on the level of values will prevent
diversified teams from being effective and efficient as long as shared goals and trust are lacking. Such problems are seen as typical for this approach, because differences are more salient here than similarities (see DiStefano and Maznevski 2000, Van der Veg, Bunderson 2005; see also Roberson and Kulik 2007).

Moreover, the approach has to deal with strong tendencies among male and female employees to leave balanced groups. Chatman and O’Reilly (2004) have shown that female employees report the lowest likelihood of leaving male- or female-dominated groups, whereas male employees “were most eager to remain members of homogeneous or male-dominated groups and also most eager to leave balanced and female-dominated groups – that is, they were more eager to leave their work groups as the proportion of women in their work groups increased”.

Tendencies toward homo-social reproduction might even prevail when they run counter to strategic considerations. Boone, van Olfen, van Witteloostuijn, and de Brabander (2004) studied Dutch top management teams and concluded: "Apparently, top management teams tend to close ranks when environmental complexity and pressure increase." The authors consider a possible behavioural explanation: Threats to the team’s survival may become more dominant than the strategic considerations of the organization. Furthermore, the authors focus on process losses resulting from team diversity, and argue that in highly uncertain situations, they can be an appropriate attempt to secure short-term profitability (Boone et al 2004).

Hence, human resources management is confronted continuously with the task of reproducing balance in groups in the face of counter movements or of stabilizing the minority status of women. This situation will only be overcome through learning processes in which long-term strategic considerations gain momentum and non-dominated diversified groups become valued by the organization and the individuals involved.

Nonetheless, the positive aspect is that more members of minority groups gain access to attractive posts, particularly in marketing but also in product development, compared with companies that have not even taken up the topic of diversity. On the other hand, these posts are then no longer available to the dominant group, which may well lead to resistance and pose a strong threat to the concept of diversity management should positive effects be smaller than expected or fail to materialize.

The learning and effectiveness approach

This framework interprets diversity management as learning for the organization as a whole. The concept creates the scope for every employee to contribute her or his individual personality with all its accompanying social and cultural relations. Böhm calls for a “fair organization” in which qualification and suitability are valid criteria and not (social) differences (2007). The aim of the learning and effectiveness approach is that employees should not subjugate their individuality and originality to homogenization strategies, but apply diversity productively in their activities and decisions at the workplace as well. This calls for a positive attitude toward the necessary increase in complexity in a company, and requires a productive approach to the tensions arising from a diversity of attitudes, experiences, and actions. A company becomes a learning organization that will offer both women and men equal scope for development if it should consider the gender dimension to be important.

The goal of diversity management is to make organizations more successful. Whereas the fairness and discrimination approach attempts this only passively by preventing sanctions, diversity in the access and legitimacy paradigm represents a resource that can be tapped
temporarily. Within the learning and effectiveness paradigm, diversity is viewed as an opportunity to increase an organization’s effectiveness and its ability to learn. Diversity management is applied as a management technique for dealing successfully with the existing personnel diversity; for avoiding loss due to strife, de-motivation, and fluctuation; and for tapping the recognized potentials of the employees efficiently. Those approaches can be classified according to a differentiated schema with the functions of adaptation, goal attainment, integration, and latent structure retention (see Hansen and Aretz 2002). Using this schema, diversity management in the fairness and discrimination and access and legitimacy paradigms clearly fits the short-term-oriented function of adaptation whose task is to mobilize resources: In those paradigms, diversity has to "pay off," and this effect has to be rapid and confirmable (see Stuber 2003, 2007).

Diversity management is functional for organizations that require diversity to meet the demands of their environments and mobilize resources on different markets (sales, procurement, labor, and capital markets). Those resources can and often will be related to financial inputs. Nevertheless, as Lederle (2007) shows for Germany the institutionalization of Diversity Management can be interpreted as “… an attempt to fulfil expectations from the organizational environment in order to gain legitimacy” – the latter being, on my opinion, an important non-financial resource in itself leading to an increase of a corporation’s reputation as a non-discriminating organization. In this framework, companies, and likewise universities, respond very quickly, as our own interviews have shown, as long as they are aware that they can apply diversity to mobilize resources in an economically meaningful way. On the other hand, in this approach, it is not logical to even start to build it up or break it down in other environmental constellations. This perspective corresponds to a short-term shareholder value approach and has to be viewed skeptically from a gender policy perspective.

In the learning and effectiveness approach, diversity management follows a medium-term perspective. The focus is no longer on just the use or even exploitation of potential resources, but on fostering and developing them. From a systems theory perspective, the concern is with the functions of goal attainment on the strategic level, that is, with effectiveness, and also with integrating personnel in order to build up or maintain the coherence that will increase corporate value. In this context, legitimacy gains an even higher importance. This corresponds with the modern "enlightened" approach to the shareholder value concept currently being demanded by representatives of German industry.

For example, at the Frankfurt conference "Women in European Business 2003," leading representatives of companies such as Deutsche Bank (company spokesman: Ackermann) and MG Technologies (CEO: Neukirchen) complained that the short-term-oriented shareholder value concept is causing the stock exchange value of companies to become increasingly dissociated from their real value, and that this must eventually lead "the bubble to break" and result in a massive loss of capital. They called for a shift from the fixation on quarterly reports and short-term profit expectations, which have led to drastically false orientations in the past. They demand a reorientation toward medium-term which increases in the company value that then cover intangible assets, also, and, above all, the potential of human resources. The diversity concept of Deutsche Bank was mentioned explicitly in this context. This, according to the company spokesman, delivers "tangible economic gain." On its website announcing the

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3 Nevertheless, this discussion has recently been challenged. Kossek, Lobel and Brown (2006) demand the diversity discourse to “broaden beyond the business case”. Litvin postulates a change in perspective and make sure that the “growth, development, survival and happiness of human beings take their appropriate place as ends or terminal values” (2006:89).
"Women in European Business" conference, which we cite below in part), Deutsche Bank declared:

It is clearly confirmed that diversity contributes to increasing the value of companies . . . . Therefore, diversity should be integrated into recruitment, promotion, and personnel development. Moreover, this is also becoming increasingly important in the criteria that analysts use to evaluate companies. Recent surveys indicate that information that cannot be grasped numerically on, for example, the management of a company and the qualifications of its personnel (non-financial information or intangible assets) . . . already make up 35% of an investor's decision. It can be concluded that diversity, as one component of these intangible assets, is an essential company strategy (www.cybertecture.de/WEB/kon_03dive.shtml).

This is not an isolated opinion, as is well-confirmed by the company and research reports compiled by Belinzski, Hansen and Müller (2003). It is also in line with results reported by Deal and Kennedy (1999) who analyzed longitudinal studies in the United States from a cultural perspective, while additionally carrying out their own research on the economic growth of culture-competent companies. They concluded that a "robust" culture is a major determinant of a company's future commercial success. Referring to the banking sector, which the authors viewed as one of the "most diverse industries of the world," Deal and Kennedy (1999) evaluated diversity explicitly: "Strong cultures arise anywhere. Where the environment demands diversity of thought and action, robust cultures will mirror the demand and foster diversity in the ranks". They illustrated their beliefs succinctly when analyzing a case study: "Different strokes for different folks, you might say, but only if the strokes make sense in the existing business environment" (Deal and Kennedy 1999).

Managing Diversity

Diversity can be a strategic resource for organizations. In France in Germany, and, more recently, in Switzerland, an increasing group of corporations and non-profit organizations is pursuing the initiative of "The Charta of Diversity". Until October 2007, 127 German firms and NPO signed "The Charta of Diversity", among these German units of Commerzbank, Ford, IBM, IKEA, Lufthansa, Manpower, McDonalds, SAP, Volkswagen, further a lot of small and medium-sized corporations, which are specifically supported by the initiative, educational institutions as universities, radio stations, and TV. All those are convinced to produce positive effects by diversity management in a competitive environment.

Nonetheless, as discussed above, diversity does not necessarily produce positive effects:

"…recent research has begun to question the simplistic diversity promotes-performance model in order to consider how (via what mediators or intervening variables) and when (in the presence of what moderators) expertise diversity might lead to higher or lower performance." (Van der Vegt/Bunderson 2005, see also Kossek, Lobel and Brown 2006, Lederle 2007, Roberson and Kulik 2007).
Cronin and Weingart argue that “representational gaps” connected to functional diversity in teams “... are likely to create conflict as team mates try to solve what are essentially incompatible problems” (2007) thereby producing “...process losses in teams that can undermine both creativity and basic effectiveness (2007). Leenen, Scheitza and Wiedemeyer (2006) deduce from their research executed in Germany that many corporations “could not make up their minds between supposed advantages of cultural diversity and fear concerning possible effects”. As DiStefano and Maznevski (2000) show in case of multicultural teams, “diverse teams tend to perform either better or worse than homogeneous ones, with more performing worse”. The outcomes depend on how well diversity is managed in a firm. As Stuber (2007:438) points out: “No return without investment” thereby stating that German firms expect a positive outcome of their investment into diversity management.

A pro-active diversity management is a requirement which has to provide an appropriate framework in which effective actions can unfold (Böhm 2007). Hansen and Aretz propose a holistic approach, based on the system’s view of the AGIL concept (Hansen/Aretz 2002, 2006, Aretz/Hansen 2002). This approach combines the following functions

Latent pattern maintenance by creating a diversity vision compatible with the organization’s values,

- Integration by developing an attitude towards diversity based on the needs of the organization and their members which prevents the split off of particular diversity dimensions,
- Goal attainment by building enabling systems and connecting them to existing systems,
- Adaptation to the organizational needs and resource mobilization in form of financial support, information and commitment to diversity and diversity management.

Following those recommendations, organizations should begin by finding a core group of promoters who start the process. At least one representative of the top management should be committed to diversity and diversity management, thereby fulfilling the function of a “power promoter”. Other promoters should dedicate to content management as an expert in diversity issues and to managing processes of DM implementation. The core group analyses the specific requirements of the organization and its relevant stakeholders. Here, the focus on the “business case” should be opened to the broader view on the needs and demands of individuals involved in different stakeholder roles. Setting up a “Strategy Map” connected to Diversity Management can be helpful to identify the distribution of diversity management to the organizations main goals (see Aretz/Hansen 2002). Based on the actual needs, the core group develops a diversity vision which is communicated in the next step to multipliers inside the organisation. Thereby commitment is created and further mobilized. This can and often must be supported by trainings and other skill building measures. Enabling systems (at least a project group or task force in the beginning) must be built, continually improved and connected to existing systems (communication, MbO, HRM appraisal and gratification, recruitment). For instance, conditions which create “stereotype threat” (Roberson and Kulik 2007) have to be taken into consideration and must be modified. If a “Balanced Score Card” (BSC) exists, this can be used to integrate Diversity Management goals into the organization’s system of objectives.

As soon as first results and positive effects of diversity are realised, those should be communicated in order to increase commitment inside and outside the organisation. Existing networks should be involved and the emergence of new networks encouraged (e.g. Women in
Management, Rainbow, parents’ networks or networks of people being in charge for looking after elderly relatives). In this stage the scope of diversity management activities can broaden, following the needs of the stakeholders involved. Nevertheless, this should be done carefully and preferring smaller steps and a more sustainable process. Diversity is not a project but rather an ongoing process:

“It’s an initiative, not a program. At Deloitte and Touche, we don’t like the use of the word ‘program’ to describe our diversity initiative. Instead, we use the term ‘initiative’.” This may seem a trivial distinction, but it’s not. ‘Program’ implies a project-like mind set with a definite beginning and an ending. ‘Initiative’, on the other hand, defines a process, a significant long-term investment. An initiative approaches diversity and inclusion through a sustained, systemic methodology, and the process and lessons become engrained in the very fabric of the firm.” (Anderson 2003).

This point of view was confirmed by other corporations as well. Diversity management aims on changing the culture of forms and therefore needs a sensitive, firm-specific approach and a more staying power. “Making it last” (Becker, Huselid, Ulrich 2001:189, see also 203 pp) is an indispensable step in organizational change. Adaptation to changing conditions, communicating change efforts, valuing and celebrating progress, and, particularly, communication and behaviour of management and especially top-managers as role models, are necessary parts of diversity management. This prevents diversity from becoming a “Schön-Wetter-Strategie”, as we call it in Germany – a strategy pursued just in easy times. Instead, diversity and diversity management must become integrated into the identity of the learning – and performing – organization.

References


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THE ROLE TO BONE HEALTH OF THE ELDERLY WOMEN: WALKING VERSUS AGING

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Abstract
The objective of this study was to assess the walking form that is most effective to counterwork age-related bone loss in elderly women. A cross-sectional study was conducted in a suburban area in Japan. Subjects were 200 community-dwelling elderly women aged 65-85 years. Bone status was determined in right heel with quantitative ultrasound and indicated as stiffness index (SI). Walking parameters including usual and maximum walking speed (UWS and MWS), daily walking steps (DWS) and block-crossing, and two covariates – muscle mass and maximum bite force – which have been shown to correlate with bone in our previous study, were examined objectively. Data were analyzed by SAS for Windows, Ver. 8.2. The results showed that SI and all walking parameters negatively correlated with age (p<0.01). In women aged 65-74 years, SI correlated significantly with MWS, UWS, and DWS after adjustment for covariates, and stepwise multiple linear regression analysis showed MWS to have the strongest influence on SI. In women aged 75+ years, only DWS correlated with SI after adjustment for covariates, and it also was shown to have the strongest influence on SI. We concluded that walking form that best counterworks age-related bone loss differs with age among the elderly women. Age-appropriate walking form should be considered to prevent osteoporosis in elderly women.

Key words: Bone health – Elderly – Walking – Aging


Introduction
Aging should be addressed worldwide as the elderly population is expanding rapidly. To prevent a great social burden in the future, the prevention of osteoporosis and related fractures, which are main causes of the disability of the elderly (De Laet and Pols 2000, Riggs and Melton 1995), emerges as a major issue to maintain independent life of the elderly.

In strategies of osteoporosis prevention, physical exercise is highly recommended as the first step, not only because it can increase peak bone mass in young people and reduce bone loss in the elderly, but also because it can increase muscle strength, coordination, balance, and flexibility, which may help prevent falls (Kai et al. 2003). Walking is accepted as a particularly feasible form of physical exercise for the elderly because of the inevitable decrease of mobility with age (Shumway-Cook et al. 2007). Therefore, the effects of various walking parameters, such as usual and maximum walking speed (UWS and MWS), and daily walking steps (DWS), on bone health of the elderly have been studied (Sun et al 2007, Kitagawa et al 2003, Yanagimoto et al 2000). However, the decrease of mobility tends to accelerate with age (Forrest et al 2006). The older an individual becomes, the lower the level of mobility he/she experiences. Interesting, physical exercise has both beneficial and detrimental effects on bone health; high-
intensity activities can result in osteopenia (Kesäniemi et al 2001). These facts arise the issue: what type of walking is the most effective and feasible to counterwork age-related bone loss among the elderly?

In our previous study (Sun et al 2007), walking speed, muscle mass (MM), and maximum bite force (MBF) were identified objectively, along with body compositions, muscle strength, mobility ability, daily physical activity, and masticatory function, to be crucial factors for bone health of the elderly. On the basis of our previous study, we now come into a design: in the same population and with adjustment for MM and MBF, to assess the walking form that is the most effective to counterwork age-related bone loss.

UWS, MWS and DWS have been reported to contribute to bone health of the elderly (Sun et al 2007, Kitagawa et al 2003, Yanagimoto et al 2000). These factors are included in this assessment. In addition, considering that tripping indoors or outdoors is the most common cause of falls (Lord et al 1993, Berg et al 1997), we also take block-crossing walk into account, even though its effect on bone health has not yet been reported. Therefore, bone health, walking parameters including UWS, MWS, DWS and block-crossing walk, and two covariates (MM and MBF) were measured objectively in the same participants of our previous study with the purpose to identify the walking form that best counterworked age-related bone loss in the elderly.

Material and Methods

Subjects

Since bone loss is accelerated after menopause and prevalence of osteoporosis is high in elderly women, only female participants of our previous study (Sun et al 2007) were included in the present study. Subjects comprised 200 community-dwelling women who were 65-85 years old, were registered at welfare centers for the aged in a suburban area in Japan, and had not taken any therapy or intervention for osteoporosis during prior year. All measurements were performed during the period May-June 2006.

Measurement of bone health

Bone status was measured in the right-heel with A-1000 EXPRESS quantitative ultrasound bone densitometer (GE Lunar, Madison, WI, USA). Stiffness index (SI), derived from the combination of ultrasound attenuation and speed of sound, was taken as an indicator of bone health, as described in our previous study (Sun et al 2007).

Measurement of walking parameters

UWS and MWS were measured by asking participants to walk straight ahead for 11 meters at their usual speed and as quickly as possible without running. Walking speed was derived from the middle 5 meters (Shinkai et al 2000).

DWS was monitored for 7 full days by attaching a Kenz Lifecorder EX electronic pedometer (Kenkou Corp., Suzuken, Japan) to the subject’s belt. Walking steps recorded by the pedometer were included in the analysis only if the pedometer was worn by the subject for more than 10 hours per day. The average number of steps taken per day for 7 days was calculated as DWS (Saito et al 2004).

Block-crossing walk was determined according to the guidelines provided by the Japanese Ministry of Education, Culture, Sports, Science and Technology (Japanese Ministry of
Education, Culture, Sports, Science and Technology 2006). The blocks were made of 100 cm long × 20 cm high × 10 cm wide foam. They were placed parallel, 2 m apart, along a 10 m walkway including both ends. Participants were asked to walk as quickly as they can to negotiate the blocks. This was done twice, and the shorter time was recorded as the block-crossing walk time.

**Measurement of two covariates**

Two covariates – MM and MBF – were measured similarly to our previous study (Sun et al 2007). MM (kg) was determined with a BC-118D Body Composition Analyzer (Tanita Corp., Tokyo, Japan) with the subjects in the standing position, and the data after adjustment for height squared (m²) were used. MBF was determined with Dental Prescale Occlusor FPD-707 (Fujifilm, Tokyo, Japan).

**Statistical Analysis**

The relation between SI with age and the correlations of walking parameters with SI and age were tested by Pearson correlation. To control the effect of age, the subjects were divided into two groups: a young-old (65-74 years old) group and an old-old (75+ years old) group, with referring the age-stratification often adopted in the field of geriatrics (Magaziner 1989). The effects of walking parameters on bone health were assessed separately within each age group. Correlations between SI and each parameter without and with adjustment for MM and MBF were tested by Pearson correlation and Pearson partial correlation. The walking parameter that was associated most strongly with SI was assessed by stepwise multiple linear regression analysis after MM and MBF were fixed in the model. SAS for Windows, Ver. 8.2, was used for all statistical analyses.

**Results**

Subject characteristics are shown in Table 1 and the effect of age on SI is shown in Figure 1. SI decreased significantly with age (r=0.30, p<0.001) in elderly women. However, the correlation between SI and age was not significant in each age group (p>0.1).

Correlations of walking parameters with SI and age are shown in Table 2. UWS, MWS and DWS have significant positive correlations with SI and significant negative correlations with age. Block-crossing walk time has a significant negative correlation with SI and significant positive correlation with age.

The assessment of the effects of walking parameters on bone health in young-old women is shown in Table 3. Both without and with adjustment for MM and MBF, UWS and MWS correlated significantly with SI, and DWS correlated weakly with SI. Stepwise multiple linear regression analysis showed that MWS was associated most strongly with SI.

The assessment of the effects of walking parameters on bone health in old-old women is shown in Table 4. Without adjustment for MM and MBF, DWS and UWS correlated weakly with SI, and block-crossing walk was significantly correlated with SI. With adjustment for MM and MBF, only DWS correlated significantly with SI. Stepwise multiple linear regression analysis showed that DWS has the strongest association with SI.
Discussion

Our results indicated that the walking form that best counterworked age-related bone loss in elderly women differed with age. In young-old women, maximum walking speed (MWS) contributed most strongly to bone health, whereas daily walking steps (DWS) have the strongest effect on bone health in old-old women.

There could be several reasons for this difference. With age, individual experiences an inevitable decrease of mobility. As observed among our subjects, the correlation coefficients between age and all walking parameters were in the range from 0.32 to 0.55, the rather strong correlations. Consequently, old-old women have considerably weaker mobility than young-old women. It has been reported that the persons aged 75 years and over frequently have difficulty moving even indoors (Sainio et al 2006). Thus, an activity that is modest for young-old women might be intense for old-old women. However, intense physical exercise can increase the risk of osteoporosis (Kesäniemi et al 2001). Aging together with the dramatic effect of physical exercise on bone health suggests that the difference in walking form that best contributes to bone health between young-old women and old-old women might be reasonable.

Of the walking parameters assessed in the present study, walking speed (UWS & MWS) reflects mainly lower limb muscle strength and balance (Tiedemann et al 2005; Suzuki et al 1990). In comparison to UWS, MWS demands stronger limb muscle strength, more energy expenditure, and greater balance, and it declines more steeply with age (Bohannon 1997, Malatesta et al 2003). Thus, MWS tends to represent a higher degree of mobility capability and to exert more effect on bone status than UWS. However, MWS might be difficult for the rather old people, as found by Shinkai et al (Shinkai et al 2000); over 5 percent more old-old persons than young-old persons could complete the usual walking task but could not complete the maximum walking task. DWS is not confined to limb muscle strength or balance. Activities of daily living such as housekeeping, shopping, and leisure-time activities are taken into account. DWS represents the level of physical movement actually performed in daily life, but it does not reflect the mobility capability. Therefore, DWS could be feasible for any non-disabled elderly regardless of mobility.

In the present study, MWS was shown to have stronger correlation with bone health than UWS and DWS in young-old women. Moreover, it was identified to be the walking form that best contributed to bone health in young-old women, coinciding with our previous study (Sun et al 2007). However, results were to the contrary in old-old women, and DWS was found to correlate most strongly with bone health of old-old women. In view of above comparison among these walking parameters and the prominent difference in mobility between young-old women and old-old women, MWS demanding high level of mobility might have been appropriate for young-old women but too intensive for old-old women. By contrast, DWS as an indicator of actual daily movement might be appropriate for old-old women. Since intense physical exercise can result in osteoporosis (Kesäniemi et al 2001), MWS seems to best contribute to bone health in young-old women, whereas DWS could be the most crucial to bone health for old-old women.

As for block-crossing walk, it requires much more attention and executive function (Brown et al 2005, Ble et al 2005) than does walking only. It reflects the ability to incorporate visual input into the planning and performance of the respective motor task. Elderly persons with central nervous system deficits will have difficulty negotiating the obstacles. As a result, block-crossing walk seems to be beneficial especially for fall prevention rather than bone health.
The present study was a cross-sectional study, and the persons with limited mobility were excluded. Therefore, all conclusions drawn from this study need to be confirmed by further prospective study or intervention programs.

In conclusion, we first evaluated the effects of various walking forms on the age-related bone loss in the elderly women and found that MWS was the walking form that best contributed to bone status in young-old women and that DWS was the most influential walking form in old-old women. According to these findings, we propose that walking exercises in different intensity aimed at different age stratifications should be advocated in health campaigns for prevention of osteoporosis in the elderly.
### Table 1. The subject characteristics

<table>
<thead>
<tr>
<th>Variables</th>
<th>N</th>
<th>Mean±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>SI</td>
<td>200</td>
<td>69.1±11.32</td>
</tr>
<tr>
<td>Age (years)</td>
<td>200</td>
<td>72.8±4.93</td>
</tr>
<tr>
<td>Muscle mass (kg/m²)</td>
<td>197</td>
<td>13.9±0.85</td>
</tr>
<tr>
<td>Maximum bite force (N)</td>
<td>199</td>
<td>455.6±279.9</td>
</tr>
<tr>
<td>Usual walking speed (m/sec)</td>
<td>200</td>
<td>1.42±0.24</td>
</tr>
<tr>
<td>Maximum walking speed (m/sec)</td>
<td>200</td>
<td>1.84±0.29</td>
</tr>
<tr>
<td>Daily walking steps (steps/day)</td>
<td>194</td>
<td>8067±3172</td>
</tr>
<tr>
<td>Block-crossing walk (sec)</td>
<td>200</td>
<td>9.4±2.50</td>
</tr>
</tbody>
</table>

![Figure 1. The effect of age on stiffness index](image)

$r=-0.30$

$p<0.001$
Table 2. The correlations of walking parameters with stiffness index and age

<table>
<thead>
<tr>
<th>Variables</th>
<th>Stiffness index</th>
<th></th>
<th>age</th>
<th></th>
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<tr>
<td></td>
<td></td>
<td>r</td>
<td>p</td>
<td>r</td>
</tr>
<tr>
<td>Usual walking speed (m/sec)</td>
<td>0.24</td>
<td>&lt;0.001</td>
<td>-0.37</td>
<td>&lt;0.001</td>
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<tr>
<td>Maximum walking speed (m/sec)</td>
<td>0.26</td>
<td>&lt;0.001</td>
<td>-0.45</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Daily walking steps (steps/day)</td>
<td>0.24</td>
<td>&lt;0.001</td>
<td>-0.32</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Block-crossing walk (sec)</td>
<td>-0.24</td>
<td>&lt;0.001</td>
<td>0.55</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Table 3. The assessment of the effects of walking parameters on bone health in young-old women

<table>
<thead>
<tr>
<th>Variables</th>
<th>r</th>
<th>p</th>
<th>Partial correlation</th>
<th>Stepwise regression</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td>#</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>r</td>
<td>p</td>
</tr>
<tr>
<td>Usual walking speed (m/sec)</td>
<td>0.18</td>
<td>0.04</td>
<td>0.18</td>
<td>0.04</td>
</tr>
<tr>
<td>Maximum walking speed (m/sec)</td>
<td>0.20</td>
<td>0.01</td>
<td>0.23</td>
<td>0.00</td>
</tr>
<tr>
<td>Daily walking steps (steps/day)</td>
<td>0.16</td>
<td>0.07</td>
<td>0.17</td>
<td>0.06</td>
</tr>
<tr>
<td>Block-crossing walk (sec)</td>
<td>-0.07</td>
<td>0.41</td>
<td>-0.09</td>
<td>0.30</td>
</tr>
</tbody>
</table>

#: after adjustment for muscle mass and maximum bite force
a: model= Muscle mass (fixed), Maximum bite force (fixed), Usual walking speed, Maximum walking speed, Daily walking steps, Block-crossing walk.

Table 4. The assessment of the effects of walking parameters on bone health in old-old women

<table>
<thead>
<tr>
<th>Variables</th>
<th>r</th>
<th>p</th>
<th>Partial correlation</th>
<th>Stepwise regression</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>#</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>r</td>
<td>p</td>
</tr>
<tr>
<td>Usual walking speed (m/sec)</td>
<td>0.21</td>
<td>0.08</td>
<td>0.14</td>
<td>0.29</td>
</tr>
<tr>
<td>Maximum walking speed (m/sec)</td>
<td>0.19</td>
<td>0.12</td>
<td>0.13</td>
<td>0.31</td>
</tr>
<tr>
<td>Daily walking steps (steps/day)</td>
<td>0.23</td>
<td>0.06</td>
<td>0.33</td>
<td>0.00</td>
</tr>
<tr>
<td>Block-crossing walk (sec)</td>
<td>-0.24</td>
<td>0.04</td>
<td>-0.20</td>
<td>0.12</td>
</tr>
</tbody>
</table>

#: after adjustment for muscle mass and maximum bite force
a: model= Muscle mass (fixed), Maximum bite force (fixed), Usual walking speed, Maximum walking speed, Daily walking steps, Block-crossing walk.

References

SIGNIFICANCE OF OCCLUSAL FORCE AND PHYSICAL FACTORS FOR JAPANESE ELDERLY PERSONS

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Abstract

The study aimed to identify the relative health promotion parameters to occlusal force in elderly Japanese. The subjects were 372 elderly persons (101 men, 271 women), aged 60-87 years, living in a metropolitan suburb in Japan and using a welfare center for the aged. Occlusal force and various physical factors, such as usual walking speed, timed up & go, daily walking steps, handgrip strength, body muscle mass and bone quality, were measured. Psychological and physical status and lifestyle factors were assessed by means of a self-administered questionnaire. Average occlusal force was 502.4 N in men and 372.2 N in women, and it decreased with age in both men and women. In the 60-79 age stratification, occlusal force of men was higher than that of women. Among physical measurements, after adjusting age and the number of residual teeth, occlusal force had a partial significant correlation with handgrip strength in men, with usual walking speed, timed up & go, body muscle mass in women. Among the questionnaire, occlusal force was associated with masticatory items (4 items) and lifestyle factors such as habit to take a walk, smoking status and alcohol consumption in men; and with psychological health status such as intraoral satisfaction, depression, and physical health status such as 1-km walking ability, going out alone to distant places and masticatory items (4 items) in women. The measurement of occlusal force seems to be useful for the health promotion, especially for the prevention of disability of the elderly in Japan.

Key words: Occlusal force – Elderly – Handgrip strength – Usual walking speed


Introduction

At present, Japan is the nation with both the longest average lifespan (78 years for men and 85 years for women) and proportion of aged population (21% in 2005) in the world. With increasing numbers of elderly persons, the aim of health promotion for the elderly has been focused on preventing disability. Therefore, predictors of disability of the elderly have gained added interest in recent years, and masticatory function has proved to be one of these predictors. It was reported that masticatory function correlated with activities of daily living (ADL), Instrumental ADL (IADL) and mobility ability, and was able to predict the disability of the elderly (Shinkai 2001, 2003). However, most conclusions about masticatory function were drawn from the questionnaires. Given the lack of objective data on masticatory function and the proposal in Japan that health promotion targets should be numerical, objective assessment of masticatory function has emerged as a crucial issue. Occlusal force is one of the indicators of masticatory function and has been applied widely in clinical research. However, population-
based study of occlusal force is rare in Japan.

The aim of the present study was to evaluate occlusal force in elderly Japanese and to identify its relative factors by means of both objective measurement and questionnaire.

**Material and Methods**

**Study area and subjects**

T-city is a suburban city located between the city of Osaka and Kyoto, Japan, and has a total population of 360,000. T-city residents over 60 years of age who used a welfare center for the elderly and can perform ADL independently were recruited. A total of 372 individuals aged 60-87 years (101 men and 271 women) became our subjects (Table 1). Various physical measurements were conducted at 9:30-11:30 am.

**Physical measurements**

**Occlusal force** was measured with Occluzer FPD®707 (GC, FUJIFILM, Japan) and dental prescale with 50H-type (FUJIFILM, Japan). Occlusal force of function teeth (including residual teeth, prosthetic appliance, denture) was examined. **Usual walking speed** was tested by asking the participant to walk straight ahead for 11 meters at their usual speed. Walking speed was derived from the middle 5 meters. **Timed Up & Go (TUG)** measured, in seconds, the time taken by an individual to stand up from a chair, walk a distance of 3 meters, turn, walk back to the chair, and sit down again at a safe pace (Nordin 2006). **Daily walking steps** were monitored for 7 full days by attaching a Kenz Lifecorder EX electronic pedometer (Kenkou Corp., Suzuken, Japan) to the subject’s belt. The average number of daily steps (steps/days) over 7 days was calculated as the daily walking steps (Shibutani 2007). **Handgrip strength** was determined in the dominant hand with a Grip Strength Dynamometer (Takei Scientific Instruments Co., Ltd., Japan). **Body muscle mass** was measured by bioelectrical impedance analysis system with a BC-118D Body Composition Analyzer (Tanita Corp., Japan). Whole body muscle mass (Kg) was taken as the sum of the trunk and appendicular muscle mass (Tanimoto 2007). The data after adjusting the body weight (kg) was used. **Bone quality** was tested at the right-heel with A-1000 EXPRESS QUS bone densitometer (GE Luner, USA). Stiffness index was used as the indicator of bone quality (Sun 2007).

**Self-administered questionnaire**

The **Self-administered questionnaire** included various psychological and physical health status and lifestyle factors. All responses were dichotomized for statistical analyses. **Psychological health status** included self-rated health, intraoral satisfaction and depression. Self-rated health was divided into "good" for the responses of excellent or good, and "bad" for the responses of fair or poor. Intraoral satisfaction was dichotomized as "satisfied" for almost satisfaction, "not satisfied" for dissatisfaction or inconvenience. Depression was assessed by a simple Geriatric Depression Scale (GDS-5items) and defined as "no depression" with a GDS score <2 and as "depression" with a GDS score ≥2 (Rinaldi 2003).

Physical health status comprised IADL, 1 km-walking ability (Shinkai 1999), going out alone to distant places, and ability of biting hard foods. IADL was determined by using Tokyo
Metropolitan Institute of Gerontology (TMIG) Index of Competence with the 13-item score. IADL level was described as "independence" with a IADL score ≥10, and as "dependence" with a IADL score <9 (Koyano 1991). 1 km-walking ability was divided into "can" if answering that subjects could walk on foot over a distance of 1 km without any difficulty, and "cannot" if they could not walk. Going out alone to distant places was assessed as "can" if subjects reported being able to go out to distant places by themselves or "cannot" if they reported being able to go only around the house, being independent indoors but unable to go out without help. Ability of biting hard foods such as kamaboko (steamed fish paste), beef steak and peanut, was dichotomized into "can bite" or "cannot".

Lifestyle factors included the habit to take a walk, habit to exercise, smoking status, alcohol consumption and intention to eat many foods. "Habit to take a walk" and "Habit to exercise" were defined as "yes" with the frequency of almost everyday, and as "no" with the frequency of sometimes or not. Smoking status was divided into "no" as no smoking and "yes" as smoking. Alcohol consumption was defined as "yes" for drinking almost every day and as "no" for sometimes or not. Intention to eat many foods was indicated by the dietary variety score based on the daily consumption of 10 different foods: meat, fish, eggs, milk, soybean products, potatoes, green and yellow vegetables, fruits, seaweed, and fats. Each food item was given a score of 1 for "eat everyday" or 0 for any other response. The total score was calculated by adding the scores of 10 foods. It was defined as "few" with a score <3 and as "many" with a score ≥4 (Tanimoto 2005).

**Statistical analysis**

Data are shown as Mean ± SD. The distribution of occlusal force in the age stratification was examined by one way ANOVA. Significances of individual differences were evaluated by using restricted 1.s.d. test if ANOVA was significant. The distribution of occlusal force in sex and in dichotomous items was analyzed by the Student t test. Pearson correlation coefficient was used to test the correlation between occlusal force and physical measurement items. The relation of occlusal force with physical measurement items after adjusting age and the number of residual teeth was assessed by partial correlation coefficient. All analyses were performed with the software SPSS ver14 for Windows.

**Results**

The distributions of occlusal force and the number of residual teeth by age are shown in Table 2. Average occlusal force was 502.4N in men and 372.2N in women; average number of residual teeth was 17.9 in men and 17.3 in women. The decreases of occlusal force and residual teeth with age were significant in both men and women.

The distribution of occlusal force by sex in each age-stratification is shown in Figure 1. In age groups of 60-69 and 70-79 years, occlusal force of men was significantly higher than that of women. However, this deference was not found in the age group of 80+ years.

Correlations between occlusal force and physical measurements without and with adjustment for age and number of residual teeth are shown in Table 3. Occlusal force had a significant negative correlation (r=-0.2) with age and a significant positive correlation (r=0.6) with the number of residual teeth in both men and women. After adjustment for age and the number of residual teeth, occlusal force correlated significantly with handgrip strength in men, and with usual walking speed, TUG and body muscle mass in women.
The distributions of occlusal force in self-administered questionnaire items are shown in Table 4. Occlusal force was associated significantly with masticatory items (4 items) and lifestyle factors such as habit to take a walk, smoking status and alcohol consumption in men; and with physical health status such as masticatory items (4 items), 1-km walking ability, and going out alone to distant places, and with psychological health status such as intraoral satisfaction, depression in women.

Discussion

This study is aimed at identifying the health promotion parameters related to occlusal force among elderly Japanese. Masticatory function is evaluated by occlusal force, number of missing teeth and Eichner Index (Miura 1998). Many of elderly persons have few residual teeth. Few residual teeth can achieve recovery of masticatory function with denture (Watanabe 1998). This study used occlusal force of functional teeth (including residual teeth, prosthetic appliance, denture) and evaluated the masticatory function.

The average occlusal force reported for Japanese aged 65-74 years is 408 N in men and 243 N in women (Miura 2001). Occlusal force in our subjects (502.4 N in men, 372.2 N in women) was significantly higher than the reference levels. This could due to the fact that these subjects were regular attendees at welfare centers for the aged, where various organized activities such as table tennis, dancing and singing, are available for personal enrichment, and seemed to be in good health.

In men, of the various physical measurements, handgrip strength was identified to correlate with occlusal force. Handgrip strength reflects the muscle strength of upper limb, and has been regarded as one of good predictors of disability of the elderly. According to the Ministry of Health, Labor and Welfare in Japan, elderly men with less than 29 Kg handgrip strength and elderly women with less than 19 Kg handgrip strength have been warned of high risk of disability. The correlation of handgrip strength with masticatory function has been studied. Guimaraes and Yoshino reported that this correlation was significant in both men and women, but Yamaga reported that the correlation was not significant (Guimaraes 2007, Yoshino 2005, Yamaga 2002). In the present study, the association of handgrip strength with occlusal force was found in men but not in women. This might caused by the difference of maximum power between the sexes. In this study, both masticatory function and handgrip strength were measured at momentary maximum power. Men seemed to have stronger maximum power than women. Therefore, an effect of handgrip strength on occlusal force could be observed in men but not in women.

In men, of the self-administered questionnaire items, lifestyle factors such as smoking status, and alcohol consumption were shown to correlate with occlusal force. Smoking has been reported to worsen the periodontal disease (Kato 2001) and to be a main cause of tooth loss (Miura 2001). In this study, occlusal force showed a higher value in the no smoking group than smoking group. As for alcohol consumption, we found the elderly who drink alcohol to have a high occlusal force. However, the survey with the response of drinking or not, regardless of the volume, showed that alcohol drinking was associated with tooth loss (Morita 2006). Given various benefits of appropriate alcohol consumption to health as reported previously, further study of the effect of appropriate drinking on masticatory function seems to be necessary for the oral health of the elderly.

In women, of various physical measurements, usual walking speed, TUG, and body muscle mass of the self-administered questionnaire items, psychological factors such as intraoral satisfaction, depression in women.
satisfaction and depression, and moving ability such as going out alone to distant places and 1-km walking ability were found to correlate with occlusal force. In particular, TUG as an indicator of balance while walking, and “going out alone to distant places” and “1-km walking ability” as indicators of range of moving around, were shown to be associated with occlusal force, which suggested that occlusal force could be important for mobility of the elderly, and therefore might play a role in maintaining the social activity of the elderly. In addition, depression was found to weaken occlusal force of the elderly. Perhaps, this is resulted from degradation of intraoral satisfaction and decline of moving ability. In conclusion, occlusal force, as a determinant of masticatory function, was associated with physical fitness, moving around ability, and lifestyle. The measurement of occlusal force seems to be useful for health promotion, especially for the prevention of disability of the elderly in Japan.

Table 1. The composition of subjects

<table>
<thead>
<tr>
<th></th>
<th>Age stratification (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60~69</td>
</tr>
<tr>
<td>Men (n=101)</td>
<td>33</td>
</tr>
<tr>
<td>Women (n=271)</td>
<td>114</td>
</tr>
<tr>
<td>Total (n=372)</td>
<td>147</td>
</tr>
</tbody>
</table>
Table 2. The distributions of occlusal force and the number of residual teeth by age

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Occlusal force (N)</th>
<th>No. of residual teeth</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Men</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 ~ 69</td>
<td>33</td>
<td>532.1±347.2</td>
<td>20.0±9.1</td>
</tr>
<tr>
<td>70 ~ 79</td>
<td>55</td>
<td>538.1±345.1</td>
<td>17.9±9.5</td>
</tr>
<tr>
<td>80 ~ 87</td>
<td>13</td>
<td>276.1±186.4</td>
<td>12.5±9.4</td>
</tr>
<tr>
<td>total</td>
<td>101</td>
<td>502.4±338.7</td>
<td>17.9±9.6</td>
</tr>
<tr>
<td>p-value</td>
<td></td>
<td>0.034</td>
<td>0.058</td>
</tr>
<tr>
<td><strong>Women</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 ~ 69</td>
<td>114</td>
<td>408.7±256.8</td>
<td>20.9±7.8</td>
</tr>
<tr>
<td>70 ~ 79</td>
<td>128</td>
<td>360.3±264.3</td>
<td>15.6±9.8</td>
</tr>
<tr>
<td>80 ~ 87</td>
<td>29</td>
<td>280.7±258.9</td>
<td>10.3±9.9</td>
</tr>
<tr>
<td>total</td>
<td>271</td>
<td>372.2±262.6</td>
<td>17.3±9.6</td>
</tr>
<tr>
<td>p-value</td>
<td></td>
<td>0.049</td>
<td>0.000</td>
</tr>
</tbody>
</table>

The analysis was examined by one way ANOVA.
* p <0.05   ** p <0.01   *** p <0.001
Fig.1. The distribution of occlusal force by sex within each age-stratification

Table 3. The correlations between occlusal force and physical measurements without and with adjustment for age and number of residual teeth.

<table>
<thead>
<tr>
<th></th>
<th>Men (n=101)</th>
<th>Partial correlation coefficient</th>
<th>Women (n=271)</th>
<th>Partial correlation coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlation coefficient</td>
<td>Partial correlation coefficient</td>
<td>Correlation coefficient</td>
<td>Partial correlation coefficient</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-0.274 **</td>
<td>-0.231 **</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of residual teeth</td>
<td>0.680 **</td>
<td>0.613 **</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Usual walking speed (m/sec)</td>
<td>0.133 ns</td>
<td>-0.064 ns</td>
<td>0.255 **</td>
<td>0.130 *</td>
</tr>
<tr>
<td>Timed Up &amp; Go (sec)</td>
<td>-0.126 ns</td>
<td>0.021 ns</td>
<td>-0.253 **</td>
<td>-0.101 *</td>
</tr>
<tr>
<td>Daily walking steps (step/day)</td>
<td>0.178 t</td>
<td>0.096 ns</td>
<td>0.117 *</td>
<td>-0.020 ns</td>
</tr>
<tr>
<td>Handgrip strength (Kg)</td>
<td>0.372 **</td>
<td>0.166 t</td>
<td>0.157 **</td>
<td>0.047 ns</td>
</tr>
<tr>
<td>Body muscle mass (Kg)</td>
<td>0.101 ns</td>
<td>0.024 ns</td>
<td>0.091 ns</td>
<td>0.131 *</td>
</tr>
<tr>
<td>Bone quality (Stiffness)</td>
<td>0.183 t</td>
<td>0.041 ns</td>
<td>0.116 t</td>
<td>0.083 ns</td>
</tr>
</tbody>
</table>

# adjusting age and no. of residual teeth. ns : not significant, t <0.1, *p<0.05, **p<0.01

Table 4. The distributions of occlusal force by self-administered questionnaire items
<table>
<thead>
<tr>
<th>Variable</th>
<th>Occlusal force (N)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Men (n =101)</strong></td>
<td><strong>Women (n =271)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>[Psychological health status]</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-rated health</td>
<td>good 513.8±337.9 (n =83)</td>
<td>383.5±273.2 (n =213)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>bad 450.0±347.2 (n =18)</td>
<td>330.5±216.0 (n =58)</td>
<td></td>
</tr>
<tr>
<td>Intraoral satisfaction</td>
<td>satisfied 565.7±284.5 (n =34)</td>
<td>458.4±306.2 (n =110)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>not satisfied 470.2±360.8 (n =67)</td>
<td>313.2±209.4 (n =161)</td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>no depression 521.4±335.2 (n =80)</td>
<td>399.3±271.8 (n =208)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>depression 430.0±350.3 (n =21)</td>
<td>282.7±207.2 (n =63)</td>
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</tbody>
</table>
### Physical health status

<table>
<thead>
<tr>
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<th>Independent</th>
<th>Dependent</th>
</tr>
</thead>
<tbody>
<tr>
<td>IADL</td>
<td>505.6±337.7 (n=93)</td>
<td>465.1±371.2 (n=8)</td>
</tr>
<tr>
<td></td>
<td>376.4±265.2 (n=253)</td>
<td>312.1±219.8 (n=18)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Can</th>
<th>Cannot</th>
</tr>
</thead>
<tbody>
<tr>
<td>1km-walking ability</td>
<td>507.7±342.7 (n=91)</td>
<td>454.4±312.5 (n=10)</td>
</tr>
<tr>
<td></td>
<td>386.6±267.5 (n=239)</td>
<td>264.0±193.7 (n=32)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Can</th>
<th>Cannot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Going out alone</td>
<td>513.3±343.6 (n=93)</td>
<td>375.9±258.5 (n=8)</td>
</tr>
<tr>
<td>to distant places</td>
<td>383.9±265.0 (n=245)</td>
<td>261.6±211.9 (n=26)</td>
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</table>

### Masticatory items

<table>
<thead>
<tr>
<th></th>
<th>Can bite</th>
<th>Cannot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard food</td>
<td>585.2±326.2 (n=77)</td>
<td>424.7±273.5 (n=197) **</td>
</tr>
<tr>
<td></td>
<td>236.8±224.7 (n=24)</td>
<td>232.4±163.8 (n=74)</td>
</tr>
<tr>
<td>Kamaboko</td>
<td>523.8±333.4 (n=96)</td>
<td>391.6±264.5 (n=247) **</td>
</tr>
<tr>
<td></td>
<td>91.2±73.1 (n=5)</td>
<td>171.7±121.7 (n=24)</td>
</tr>
<tr>
<td>Beefsteak</td>
<td>546.5±331.5 (n=85)</td>
<td>422.2±273.5 (n=208) *</td>
</tr>
<tr>
<td></td>
<td>267.8±282.2 (n=16)</td>
<td>207.0±120.0 (n=63)</td>
</tr>
<tr>
<td>Peanut</td>
<td>556.3±331.2 (n=79)</td>
<td>447.2±273.4 (n=181) **</td>
</tr>
<tr>
<td></td>
<td>273.0±261.5 (n=22)</td>
<td>221.3±153.2 (n=90)</td>
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### Lifestyle

<table>
<thead>
<tr>
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<th>No</th>
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<tbody>
<tr>
<td>Habit to take a walk</td>
<td>554.2±335.7 (n=53)</td>
<td>445.1±336.1 (n=48)</td>
</tr>
<tr>
<td></td>
<td>387.4±277.2 (n=131)</td>
<td>357.9±248.2 (n=140)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habit to exercise</td>
<td>552.6±295.6 (n=24)</td>
<td>486.8±351.4 (n=77)</td>
</tr>
<tr>
<td></td>
<td>371.1±296.7 (n=49)</td>
<td>372.4±255.1 (n=222)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking status</td>
<td>540.0±357.0 (n=78)</td>
<td>401.3±293.6 (n=53)</td>
</tr>
<tr>
<td></td>
<td>374.8±263.8 (n=261)</td>
<td>371.9±263.1 (n=249)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol consumption</td>
<td>604.1±358.6 (n=48)</td>
<td>401.3±293.6 (n=53)</td>
</tr>
<tr>
<td></td>
<td>374.6±262.7 (n=22)</td>
<td>371.9±263.1 (n=249)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Many</th>
<th>Few</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intention to eat</td>
<td>536.4±367.4 (n=52)</td>
<td>466.3±304.9 (n=49)</td>
</tr>
<tr>
<td>many foods</td>
<td>384.1±276.2 (n=154)</td>
<td>356.5±243.8 (n=117)</td>
</tr>
</tbody>
</table>

† p <0.1, *p <0.05, **p <0.0
References

THE COMBINED EFFECTS OF OCTREOTIDE AND ORAL GLUCOSE ON THE RISE OF BLOOD GLUCOSE LEVELS AT EARLY STAGES AND ON IMPROVEMENT OF SURVIVAL RATE IN MONOCHLOROACETIC ACID EXPOSURE IN RATS

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Department of Hygiene and Public Health, Osaka Medical College, 2-7 Daigakumachi, Takatsuki City, Osaka 569-8686, Japan

Abstract

This report deals with the combined therapeutic effect of subcutaneous injection of octreotide and oral glucose administration to monochloroacetic acid exposed rats. The control rats group was subcutaneously injected with 80 mg/kg of sodium monochloroacetate and infused with 2 mL/hour 10 % glucose solution for 10 hours starting 1 hour after exposure. Group A was given 2 g/kg of oral glucose after exposure, and then infused with glucose as control. Group B was given 2 g/kg of oral glucose and a subcutaneous injection of 30 µg/kg octreotide after exposure, and then infused with glucose as control. The 14-day survival rates were 0.35 (control), 0.50 (Group A) and 0.90 (Group B). The blood glucose of Group B increased to 188 mg/dl at the beginning of the glucose infusion, significantly higher than Group A. Although there were significant differences in the lactate levels between the three groups, the levels were not abnormally high. In conclusion, our study suggests that it is important to elevate the blood glucose levels within 1 hour after monochloroacetic acid exposure. In addition, a combination of subcutaneous octreotide and oral glucose is advantageous to maintain high blood glucose level at early stages after exposure and may be an effective therapy for monochloroacetic acid intoxication.

Key words: Glucose infusion – Monochloroacetic acid – Oral glucose administration – Octreotide – Therapy

Introduction

Monochloroacetic acid (MCA, ClCH₂COOH) is widely used in the chemical industry as intermediate in the synthesis of carboxymethylcellulose and other compounds (Dartsch et al 2000). It is usually commercialized as an 80 % solution for industrial use (Kulling et al 1992). Accidental fatal exposures to MCA in chemical industries have been increasing in recent decades (Quick et al 1983, Kusch et al 1990, Kulling et al 1992, Rogers 1995).

Accidental skin exposure to high concentrations (80 %) of MCA solutions that only cover 25 % of the body surface can cause lethal systemic poisoning. MCA is highly corrosive to tissues and is 25-40 times more toxic than acetic, dichloroacetic or trichloroacetic acids (Rogers 1995). Systemic poisoning starts within a few hours and the reported symptoms include disorientation, agitation, cardiac failure and coma. Damage occurs to various organs such as liver, heart, central nervous system and kidney (Hyes et al 1973, Kulling et al 1992).
The main toxic mechanism of MCA is its inhibition of glyceraldehyde-3-phosphate dehydrogenase (GAPDH). Animal experiments have shown that MCA inhibits gluconeogenesis by inactivating GAPDH in the liver leading to hypoglycemia, which may involve degradation of gluconeogenic amino acids and result in the increase of pyruvic and lactic acid concentrations (Sakai et al 2005).

It is important to prevent hypoglycemia and maintain a high blood glucose levels at the early stages after MCA exposure. It has been reported that continuous parenteral infusion of high-dose glucose solutions for 10 hours could be an effective therapy for MCA poisoning. Lactic acidosis caused by MCA was suppressed by a high-dose glucose infusion, with an excellent inverse linear relation between blood glucose and blood lactate levels (Shimizu et al 2002). Previous studies suggested that increasing blood glucose after MCA exposure could be an effective measure, but if the glucose infusion is to be performed at a medical facility, the time it takes to transport MCA exposed individuals from their workplace to a suitable medical location and then start the treatment becomes a problem.

Oral glucose administration is the easiest way to increase glucose levels, but the increase of blood glucose may not be sufficient because of the insulin response caused by hyperglycemia. Thus an improved life-supporting therapy becomes necessary to raise the blood glucose concentration more efficiently.

Octreotide is a somatostatin analogue and suppresses the secretion of insulin (Shimatsu et al 1991), glucagons, and growth hormone (Pless et al 1986). It is used for the treatment of hypoglycemia of pancreatic islet cell tumors (Emoto et al 1993). It was reported that during oral glucose (2 g/kg) loading in conscious rats, the subcutaneous administration of a high-dose (30 μg/kg) of the somatostatin analogue SMS 201-995 suppressed insulin secretion and caused a significant increase of blood glucose levels, whereas lower doses (1 μg/kg) of the analogue did not affect blood glucose levels (Shimatsu et al 1991).

As a procedure, it is easier to administer glucose orally concurrently with subcutaneous octreotide than to infuse glucose after a MCA exposure. In the present study we report the therapeutic effects of combined octreotide and oral glucose administration on blood glucose, lactate, and survival rate of MCA-exposed rats.

Material and Methods

Chemically pure grade sodium monochloroacetate (Na-MCA) was purchased from Nacalai Tesque (Kyoto, Japan). Na-MCA was dissolved in distilled water. Saline solution and 10 % and 50 % glucose solutions were purchased from Otsuka Pharmaceutical Co, Ltd. (Tokyo, Japan). Octreotide acetate was purchased from Wako (Kyoto, Japan).

This study was carried out in accordance with the Guidelines for Animal Experiments at Osaka Medical College, Law Concerning the Care and Control of Animals (No. 105) and the Japanese Government Notification on Feeding and Safekeeping of Animals (Notification No. 6 of the Prime Minister’s Office).

Sixty ten-week-old male Sprague-Dawley rats (mean weight 300 g) were used in this study. They were housed in an air-conditioned room at 22±1°C in a 12-hour/day-illumination cycle. The rats were given free access to tap water and food (Funabashi Farm MM - 3, Funabashi City, Chiba, Japan) for 7 days.

After starving the animals for 12 hours, the rats were subcutaneously injected with a LD99 dose (80 mg/kg) of Na-MCA (Shimizu et al 2002) and divided into three groups. The control group (n=20) was infused with 2 mL/hour 10 % glucose solution for 10 hours, 1 hour after Na-
MCA exposure. Group A (n=20) was given 2 g/kg of oral glucose immediately after an MCA exposure, and 1 hour later they were infused with 10% glucose as described for controls. The rats in Group B (n=20) were also given 2 g/kg of oral glucose and a subcutaneous injection of 30 µg/kg octreotide immediately after exposure, and then infused with glucose like the other groups.

With the rats kept under phenobarbital anesthesia, the 10% glucose infusion was performed via a catheter placed in the right cervical vein for 10 hours at the rate of 2 mL/hour by means of a Model PHD 200P syringe pump from Harvard Apparatus, Inc, USA.

Capillary blood samples were obtained by puncturing the rats’ tails for determination of blood glucose and blood lactate. The measures were made at the beginning of the infusion and at 1-hour intervals during the 10-h infusion. Glucose was determined with a Dexter-ZII blood glucose meter and lactate with a Lactate ProTM lactate analyzer (ARKRAY, Japan). The survival rates of the rats in all groups were observed for 14 days after administration of Na-MCA.

The SPSS v.11.0 software was used for the statistical treatment of the data. Chi-square analysis was used to analyze the 14-day survival rates in the three groups. The Mann-Whitney test was used to establish differences in the mean values of blood glucose and lactate levels. A p value of less than 0.05 was considered statistically significant.

Results

As shown in Figure 1, the 14-day survival rate was significantly higher in Group B (0.9, p<0.05) than in the controls (0.35). Group A survival rate was higher (0.5) but the increase was not statistically significant.
Fig.1. Survival rates at 14 days after administration of LD99 Na-MCA in three study groups (n=20, each group). All groups were infused with 10 % glucose solution for 10 hours, 1 hour after exposure.

  - Control group (glucose infusion only)
  - Group A (oral glucose + glucose infusion)
  - Group B (oral glucose + subcutaneous injection of octreotide + glucose infusion) **p<0.01, NS: not significant

Figure 2 shows the results of the blood glucose levels. At the beginning of the glucose infusion the blood glucose levels showed a significant increase (about two-fold) in Group B (188 mg/dl) and Group A (144 mg/dl) relative to controls (93 mg/dl). The differences between Group A and B also were significant.
Fig. 2. Changes of blood glucose levels in three study groups. Each group included 20 subjects. All groups were infused with 10% glucose solution for 10 hours, 1 hour after Na-MCA exposure. *p < 0.05, **p < 0.01

The blood lactate levels (Figure 3) in the controls showed increases 8 and 9 hours after exposure. The blood lactate levels in Group A increased at 2 and 3 hours and those of Group B hardly changed. The blood lactate levels in Group B were significantly higher than those of the control group at the beginning of the glucose infusion. Although there were significant differences in lactate levels between the three groups, the values were not abnormally high.
Discussion

Our previous research revealed that rats showed hypoglycemia of around 50mg/dl after 2 hours of exposure to a LD99 dose (80 mg/kg) of Na-MCA (Shimizu et al 2002). However, hypoglycemia was not observed in this study as the glucose infusions were performed in all groups after 1 hour of MCA exposure. The lowest blood glucose levels were observed in control group (93 mg/dl) at the beginning of the glucose infusion (Figure 2) and the survival rate was also lowest (0.35).

The 10 % glucose infusions to LD99 Na-MCA exposed rats maintained higher blood glucose levels of 150mg/dl and survival rate of 0.80 comparing to the 5% glucose infusions group which showed blood glucose levels of 100 mg/dl and survival rate of 0.14 (Shimizu et al 2002). It was therefore thought that increasing the blood glucose level within 1 hour after exposure was of importance in the treatment of an MCA exposure. Oral glucose administration is the easiest way to increase glucose levels, but we found that oral glucose administration immediately after MCA exposure was not sufficient (Figure 1).

The highest blood glucose levels were observed in Group B (188 mg/dl) at the beginning of the glucose infusion (Figure 2). This group also had the highest survival rate. Although the blood glucose levels in Group A were also higher than in the controls (144 mg/dl), the survival rate in Group A was not as high. It is possible that the blood glucose levels in the control group and Group A increased gradually because of the continuation of high-dose glucose infusion. The combined effects of octreotide and oral glucose given 1 hour at early stages after MCA exposure maintain the blood glucose level near 200mg/dl. Octreotide alone without oral glucose did not prove effective to elevate the blood glucose levels. Concerning the effect on the rise of blood glucose levels, the blood glucose levels of the group with octreotide alone without oral glucose did not show a distinct rise, the blood glucose levels of the group with oral glucose alone showed more increases (Clowes et al 2003).

It has been stated that protein degradation and lactic acidosis occur when glucose infusion is not performed early after MCA exposure (Sakai et al 2005). Although the lactate levels in the
three groups of this study were significantly different, the levels themselves were not abnormally high (Figure 3). It is possible that lactic acidosis was inhibited by the high-dose glucose infusion (Shimizu et al 2002).

MCA inhibits gluconeogenesis by inactivating GAPDH in the liver of MCA-exposed rats, thereby causing hypoglycemia and degradation of gluconeogenic amino acids, and increases the pyruvic and lactic acids concentrations (Sakai et al 2005). Therefore, maintenance of high blood glucose levels in the early stages after a MCA exposure may prevent hypoglycemia and metabolic lactic acidosis caused by MCA. This seems to be accomplished by the joint administration of subcutaneous octreotide and oral glucose.

In case of accidental exposure in factories, the commonly accepted first-aid treatment for chemical burns involves immediate decontamination by removing clothing and flushing the chemical off the skin with warm water (using a shower for large areas) for 10 minutes. The start of therapeutic glucose infusion is delayed when there are no medical facilities in the proximity, or when the transport of patients takes a long time. For example a mean call-to-initial-recorded-electrocardiogram (ECG) interval of 11.1 min was typical of patients with out-of-hospital cardiac arrest in Japan (SOS-KANTO Committee 2005).

Various antidotes for MCA (ethanol and ethanol plus N-acetylcysteine) have been studied without conclusive evidence for their effectiveness. Dichloroacetic acid (DCA) has been licensed as an antidote by the Swedish Medical Products Agency since 1999. It has been used in clinical studies in the treatment of lactic acidosis from several origins (Stacpoole et al 1989, 1992).

In conclusion: The combined administration of subcutaneous octreotide and oral glucose promptly elevates the blood glucose levels. The procedure is easier than glucose infusion for in situ treatment of MCA exposure. It is recommended that first response personnel should have octreotide always ready for subcutaneous injection in conjunction with oral glucose administration as an effective therapy in cases of MCA exposure.

References


INFLUENCE OF A LACK OF INFORMATION AND PHYSICAL ACTIVITY ON THE OBESITY RATE OF TAXI DRIVERS IN JAPAN

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Abstract

The purpose of this study is to apply the findings of these previous studies and clarify the information factor to influence the rate of obesity among taxi drivers in rural Japan. 48 taxi drivers had taken part in a local Japanese city. The research design was a case control study. Main measurement results were body height, body weight, age, gender, and BMI, amount of physical activity based on participants’ posture and intensity (PAPI). Each parameter was statistically expressed in mean and SD, condition factors (research factors) analysis using the Chi square test to evaluate the relative risk. In the results, there were 15 people in the obesity group and 33 in the non-obesity group. Regarding the amount of physical activity without bodyweight effect, they performed 38.9 % of the physical activity recorded for the non-obesity group (2375 kcal) whose coping score was 82.6 %, average age 52 years, weight 61 kg, height 167 cm, and a BMI of 21.8. Analytic results concerning the amount of physical activity without bodyweight effect showed that the amount of physical activity of the obesity group was 40.8 % (3539 kcal), the coping score was 73.3 %, age 50.5 years, weight 78.9 kg, body height 168.3 cm, and the BMI was 27.8. Only BMI displayed a significant difference in obesity group in relation to the non-obesity group. And, as for β as a dependent variable and a multiple regression coefficient, the results were as follows: prospective attitude .467 (p = .030); exercise – .401 (p = .166); knowledge of under-exercised self-check – .302 (p = .178) and – .509 (p = .013); physical use – .544 (p = .032); knowledge of exercise continuation with amount of physical activity by age, which we coordinated into 4 weights. When we had knowledge about the continuation of exercised physical activity, we decreased the obesity rate by 1.4 times (95 % CI = 1.135–1.726). Prior to possessing knowledge about the continuation of exercise, it was particularly believed that we required education to proffer such knowledge in a work management program to decrease the obesity rate by approximately 1.4 times. As for the level of the coping score, a tendency to have a rather elevated BMI was present. This may be influenced by the senses of beauty or patience typical of the Japanese. It may be a characteristic of the local culture in work management. It appeared that our intervention was necessary in order to clarify the causation of a future factor to build effective work management methods.

Keywords: Physical feature – Obesity – Taxi drivers – Information

Introduction

Obesity is a dangerous factor of damage caused to the aorta in someone who engages in static work, or jobs that require workers to sit down. For example, the myocardial blockage morbidity ratio of London bus drivers is higher than that of the conductors. Qiang et al (2005)
reported that 55% of the air taxi pilots at baseline were overweight (25 kg/m² BMI < 30 kg/m²) and 7% were obese (BMI ≥ 30 kg/m²). A follow-up study accumulated a total of 20,671 person-years with 1,897 diagnoses of cardiovascular disease, yielding an incidence rate of 92 per 1000 person-years. An incorporation of BMI into the current medical standards for commercial pilots merits serious consideration.

Kurosaka et al (2000) reported that the prevalence of myocardial infarction and multi-vessel disease was higher in the taxi-driver patients than in non-taxi-driver patients. The taxi-driver patients had a higher BMI, more instances of diabetes and smoking, higher levels of low-density lipoprotein cholesterol (LDL-C), and lower levels of apolipoprotein AI (ApoAI).

These are stress-related problems that can cause deconditioning motion insufficiency. In addition, workers across the world are facing a serious problem regarding deconditioning motion insufficiency. However, a method to sufficiently prevent obesity when a worker engages in static work has not yet been devised. Large-scale education and measures are perhaps effective to control obesity. However, humans tend to have a limited amount of time for education, and it is important to devise a method with which the desired effect can be obtained. Future investigation has been planned to determine the factor that should intervene in order to control obesity among workers who engage in static work and this is outlined as our purpose.

Purpose of the Study

This study is based on health behavior theory in work management from the 1990s. This contemporary problem is common both globally and in Japan, and it has become a significant issue in the decreasing working population, as well as a part of a program in work management that has stepped into life of a worker as a component of production capacity.

For a Japanese worker in the manufacturing industry in Okinawa who exercises, there was a lack of concern about inactivity as a result of office automation; measurements were based solely on the amount of physical activity a worker engaged in. We researched the factor of access to and promotion of awareness, and taught an easy, low intensity exercise to contribute to productivity through an improvement in health. In particular, we demonstrated that if this exercise was continued in the long term, a decline in the risk of geriatric disease could be observed, as this study overturned the influence of aging.

The purpose of this study is to apply the findings of these previous studies and clarify the information factor to influence the rate of obesity among taxi drivers in rural Japan.
Subjects
The study comprised 48 taxi drivers in a local Japanese local city. Means age of subjects was 52 years ± 8 (44–60). Their mean weight was 66 kg ± 10.8 (55.2–76.8), mean height was 167 cm ± 5.4 (161.6–172.4) and mean BMI was 23.7 ± 3.4 (20.3–27.1).

Study design
The study design was a case control study.

Main measurement parameters
The main measurement parameters were height, body weight, age, gender, and BMI. The amount of physical activity was based on participants’ posture and intensity (PAPI).

Collection of Data
This study employed record paper to use the OMR (optimum mark reader), which formulated an action record of the amount of physical activity a taxi driver performed during a 24-hour period and used software in order to automatically treat and calculate the data. (PAPI-OMR system (c) Kimura Akira)

A researcher classified the calculations of the amount of physical activity observed in posture and exercise intensity and duration, and determined energy consumption with the use of computer software.

Information about taxi drivers was accumulated and measured by a questionnaire consisting of 12 items that inquired about past and present health education.

The questionnaire contained 4 questions testing correct knowledge, 4 questions inquiring about continuation methods of an exercise, understaffed perception, and a question about exercise technology, and 4 questions related to the physical use of exercise equipment.

In addition, the driver’s degree of coping was analyzed from the answer provided for coping measurements, consisting of 25 questions.

We used multiple regression analysis and calculated the difference of the mean of two
populations and odds ratio; these data review the connections of obesity by the number of drivers and the lack of exercise among the drivers.

PA measurements with position and intensity used PAPI, which describes human motion (activity) based on two factors: 1) Subjective position and 2) Perceived exertion. PAPI is a method of determining energy consumption from a combination of these two primary factors, which are disassembled into three positions: lying, sitting, and standing.

The subjective perceived exertion is disassembled into low, moderate, and high intensity. Therefore, the movement of all humans can be expressed as a combination of the energy consumption factor of 9.

As for this method, the correlation with the heart rate is high at the time of movement in a person who has dyskinesia. For example, when a morbidly obese person walks, it is known that his or her energy consumption is high. With the METs method, at most, 1 becomes 2 METs, but with the PAPI method converted to the METs method, the calculated energy consumption is 3–4 METs.

Table 1. The table provides the coefficients of energy consumption for each human movement. The provided by the PI method. The activity translates to three postures (lying, sitting, and standing) and the perceived exertion is disassembled into low, moderate, and high intensity.

<table>
<thead>
<tr>
<th></th>
<th>LOW</th>
<th>MEDIUM</th>
<th>HIGH</th>
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<tbody>
<tr>
<td>LYING</td>
<td>0.017</td>
<td>0.023</td>
<td>0.026</td>
</tr>
<tr>
<td>SITTING</td>
<td>0.027</td>
<td>0.055</td>
<td>0.062</td>
</tr>
<tr>
<td>STANDING</td>
<td>0.045</td>
<td>0.059</td>
<td>0.091</td>
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Statistical Analysis

Each parameter was statistically expressed in mean and SD. Condition factors (research factors) analysis was made using the Chi square test to evaluate the relative risk. Multiple Regression Models analysis (Using by SPSS v10, Chicago, USA) was also used.

Results

There were 15 people in the obesity group and 33 in the non-obesity group. Regarding the amount of physical activity without bodyweight effect, they performed 38.9 % of the physical activity recorded for the non-obesity group (2375 kcal) whose coping score was 82.6 %, average age 52 years, weight 61 kg, height 167 cm, and a BMI of 21.8.

The amount of physical activity without bodyweight effect 40.8 that the amount of physical activity of the obesity group was 3539 kcal, weight, as for the coping score, as for 73.3 %, the age, as for 50.5 years old, the weight, as for 78.9 kg, the body height, 168.3 cm, the BMI was 27.8. Only BMI accepted significant difference in obesity group and ratio obesity group.

β as a dependent variable and a multiple regression coefficient, the results were as follows: prospective attitude .467 (p = .030); exercise −.401 (p = .166); knowledge of under-exercised self-check −.302 (p = .178) and −.509 (p = .013); physical use −.544 (p = .032); knowledge of exercise continuation with amount of physical activity by age, which we coordinated into 4 weights.

When we have knowledge about the continuation of exercised physical activity, we decrease the obesity rate 1.4 times (95 % CI = 1.135–1.726).
Fig. 2. Body height (cm) in non-obesity group and obesity group

Fig. 3. Body mass index (%) in non-obesity group and obesity group
Fig. 4. Body weight (kg) in non-obesity group and obesity group

Fig. 5. Age (year) in non-obesity group and obesity group

Fig. 6. Physical activity by position and intensity in

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non-obesity group and obesity group

**Fig. 7.** Coping score (numbers/120) in non-obesity group and obesity group

**Fig. 8.** Knowledge score (numbers/50) in non-obesity group and obesity group
Fig.9. The be-ta value by multiple regression model analysis. Slash line shows be-ta coefficients to PAPI by each factors. No-slash line shows p-value.

Discussion

What are the work and daily life factors that affect the health of taxi drivers? Ueda T et al (1989, 1992) reported that the questionnaire survey was conducted on 5,523 taxi drivers in Osaka Prefecture in order to investigate their working conditions and daily life, as well as the characteristics of their health condition and various other effects on health, especially on their cardiovascular system. The main results of their survey were that the rate of subjective symptoms, morbidity rate, and rate of poor physical condition over the past year among taxi drivers were higher than those of the control group. Among the subjective symptoms, the rate of gastrointestinal disorders, fatigue, musculoskeletal system disorders, sensory system disorders, hemorrhoids, etc., were especially high.

Work shift, density of work, years of experience in taxi-driving, frequency of fright while driving, meal pattern, way of recuperating on rest days or holidays, obesity, smoking, and coffee and alcohol intake were determined as the factors that affect the health of taxi drivers. Nearly half of the respondents stated that they would like to quit or change their job, and as many as 62 % provided “condition of health” as their reason. On the other hand, the rate of heart-related symptoms such as palpitation and breathlessness did not differ from that of the control group. A possible reason for this, which was deduced from the foregoing results, is that there were some who had changed or quit their job at an early stage for health reasons such as heart trouble and severe physical and mental burden resulting from taxi-driving.

Many taxi drivers are obese and the rate of those with heart-related symptoms was considerably high among those who were classified as obese. In addition, the results indicated that those with longer driving experience tended to be obese. However, that survey had not measured the amount of physical activity of taxi drivers. It followed the lack of physical activity, rather than unknown factors to facilitate health behavior.

This research revealed that the dissemination of knowledge about the methods for verifying exercise and lack of exercise should be continued as an information factor to raise the amount of physical activity of taxi drivers in a local Japanese city. This recorded activity level showed a stronger influence than age.

In particular, when we did not possess this knowledge of the continuation of exercise, it was
believed that we require education that provides such knowledge in a program of work management to decrease the obesity rate approximately 1.4 times. As for the height of a coping score, a tendency to have a rather elevated BMI was present.

A limitation of this study was that the time samples were too short. In Japan, a taxi driver works for more than 8 hours on a daily basis. The investigation, which is strictly concerning a 48-hour period, must be reviewed and considered accordingly.

Conclusions

Prior to possessing knowledge about the continuation of exercise, it was particularly believed that we required education that proffers such knowledge in a work management program to decrease the obesity rate by approximately 1.4 times. As for the level of the coping score, a tendency to have a rather elevated BMI was present. Senses of beauty or patience typical of the Japanese may influence this. It may be a characteristic of the local culture in work management. It appeared as thought our intervention was necessary in order to clarify the causation of a future factor to build effective work management methods.

References

KNOWLEDGE SHARING AND TRUST IN WORK ORGANISATIONS

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Abstract

This article focuses on trust in context of knowledge sharing. The theoretical part of the article introduces briefly the concept of trust, to be followed by a discussion on trust as an important factor and premise in sharing knowledge, especially tacit knowledge. This article introduces the work of the thematic group Knowledge Transfer and Trust in Work life ability networks. First the discussion on the concept of trust is summarised, second the instrument of building and maintaining trust is introduced. The data has been gathered in thematic group meetings during 2006-2007. The thematic group has been working on recognising the basic elements and characteristics of the complex subject of trust. The subject was approached by determining the areas of trust in work organisation. The areas were categorized into four groups: 1) interaction and trust, 2) competence and trust, 3) predictability and trust and 4) organisation culture and trust. The examination has also different levels: individual, group, organisational and society level. The instrument is still incomplete but when finished it will be utilised to build and maintain trust and to facilitate knowledge sharing in work organisations.


Key words: Trust – Knowledge – Tacit knowledge – Sharing Knowledge

Introduction

The business environment is undergoing constant change. Organisations are compelled to pay attention to knowledge and expertise of their staff in order to identify new sources of competitive edge. Instead of tangible resources, expertise and knowledge have turned into the most vital organizational factors in securing competitive edge and capital (Ståhle and Grönroos 1999, Sydänmaanlakka 2003).

In Finland as well as in other European countries tacit knowledge is a topical issue as the retirement of the baby-boomers generation will affect a multitude of organizations. The situation causes imbalance in the workforce. Organisations have started to prepare themselves to maintain competencies and knowledge in the use of organisations when experts retire (Ilmarinen et al 2003).

Tacit knowledge as experience-based knowledge of experts and its sharing play an important role. In order to facilitate sharing of knowledge organisations need to pay attention to the premises facilitating it. Trust has been identified one of the most important factors in the sharing of knowledge (e.g. Davenport and Prusak 1998, Ardichvili et al 2003).

This paper approaches the subject of trust and knowledge sharing by introducing the work
of the thematic group Knowledge Transfer and Trust operating in Work Life Ability - Networks.

The aims of this article are to
a) Examine the theoretical framework of the concept of trust in literature and in the light of the thoughts of the thematic group Knowledge Transfer and Trust
b) Introduce the instrument of building and maintaining trust in work organisations developed by the thematic group

The theoretical part of the article introduces the theoretical framework of the concept of trust and its role in knowledge sharing in conjunction with other premises. The work of the thematic group of Knowledge Transfer and Trust is introduced. First the discussion on trust and its influence on knowledge transfer is presented, to be followed by an introduction of the result of thematic group work, that is, an instrument for building and maintaining trust in the work organisation.

**Conceptual framework of the article**

**Defining trust**

The concept of trust

Trust and capital of trust have already been discussed by Fredrick Taylor and Max Weber. Taylor was a founder of scientific management, and he considered the effects of trust in work. His idea was that employees did not trust their employers. Making production more effective was against employees’ interest. With his thoughts he created a basis for discussion on trust at work. Weber, on the other hand, was interested in how reliably an organisation can be functioning and what elements explicate its operational reliability (Harisalo and Miettinen 1995).

In her article Blomqvist (1997) analyses extensive material from various disciplines in order to reach an acceptable definition of trust to be used in business research. She introduces researchers from the disciplines of social psychology, philosophy, economics, contract law and market research. The main ideas and definitions of trust from these disciplines are introduced. In social psychology trust is seen as allowing oneself to be in a potentially vulnerable position relative to another. Trust is also seen as a function of imperfect information. From a philosophy point of view trust is seen as good and the betrayal of trust is always considered wrong. Philosophers see trust as unconscious, unwanted or forced. Trust may also be absolute and unreciprocated. Economists have drawn attention to trust in relation to cooperation of firms or individuals. Trust is seen as a response to expected future behaviour. From a contract law point of view trust emerges especially when written contracts are not made and companies operate under mutual understanding and trust. In marketing trust has emerged in the relationship-marketing paradigm, where the establishment and management of trusting relationships have been emphasized. Trust is seen as a factor which leads to the constructive and cooperative behaviour that is vital in long-term relationships. Trust is also a key attribute of industrial networks and important in sales activities (Blomqvist 1997).

Blomqvist’s own definition of trust for business contexts is “an actor’s expectation of the other party’s competence and goodwill”. Competence in this definition includes, for instance, technical capabilities, skills and know-how. Goodwill implies to moral responsibility and positive intentions towards the other (Blomqvist 1997).
Kouzes and Posner (1993) have analysed trust in their book *Credibility*. They draw their ideas from a research based on broad data. In their studies trust was highlighted as one of the most important factors describing organisations’ success. Kouzes and Posner describe trust as an inexhaustible dynamo, which helps people to cope and renew. They also point out that trust has first to be found from oneself and after that from others (Harisalo and Miettinen 1995).

Social capital
The concept of social capital emerges often in scientific writings in connection with trust. Trust is an important factor when describing social capital. Mäkelä and Ruokonen (2005) generalize the discussion on social capital as follows: social capital is social structures which produce trust, good flow of knowledge, and support operating ability in society. Social capital influences society’s ability to operate, for example, by improving cooperation and coordination between individuals and societal groups and by improving reciprocal social support given by community to its members (Mäkelä and Ruokonen 2005).

Ilmonen (2000) states that social capital emerged as a counterbalance to individual capital, which focuses on competence and education as increasing factor of productivity. Social capital highlights micro level economic cooperation inside and between organisations. Ilmonen summarizes the contents of the concept of social capital. It includes a) social networks and the ways they organize, b) trust between members of networks, which keeps them together and c) normative rules and reciprocal expectations connected to trust (Ilmonen 2000). Social capital has emerged in discussions and analyses of society. Mäkipeska and Niemelä (2005) define the contents of social capital in work community as including at least a) relationships and networks formed by people inside the work community, b) relationships of management and clarity of management system, c) clarity of norms and general acceptance, d) community of values, e) information flow and f) interaction (Mäkipeska and Niemelä 2000).

This article will not approach social capital theories and different definitions more extensively. The purpose is to recognize the field in which the concept of trust is highlighted.

Capital of trust
Besides social capital a more accurate concept, capital of trust, has been used to define trust. Harisalo and Miettinen (1995) define it as a conviction resulting from human interaction about how people regard other people, acquaintances and society. Capital of trust is based on interaction between people. Harisalo and Miettinen state two forms of capital of trust: personal and impersonal capital of trust. Personal capital of trust is developed when people meet and operate together. Personal capital of trust has faces, partly known history and common experiences. Its quantity and quality depends on how individuals treat each other and cope with their tasks. Impersonal capital of trust is related to spontaneously developing processes about allocations of tasks. The allocation of tasks connects people to each other and the results of their job. People benefit from each other without knowing about each other’s existence. For example, people rely on certain services and products available in society. The development of society is therefore dependent on impersonal capital of trust (Harisalo and Miettinen 1995).

*Trust as a premise in sharing tacit knowledge*

The concept of tacit knowledge
Classification into tacit and explicit knowledge plays a central role in conversations related to knowledge (Kreiner 2002). Tacit and explicit knowledge have been recognized as two dimensions of knowledge by many researchers (for example Polanyi 1966, Leonard and
Tacit knowledge has various definitions in literature but there is still a lack of a more exact scientific definition (Haldin-Herrgård 2001.) The most common definitions are based on Polanyi’s thoughts, and also Nonaka’s and Takeuchi’s definition is widely used. Nonaka and Takeuchi (1995) define explicit knowledge formal and systematic knowledge that can be expressed with words, numbers and through hard data, scientific models, coded procedure or universal principals. In their definition tacit knowledge is very personal and includes subjective opinions, intuition, hunches and experiences, ideas, values and feelings (Nonaka and Takeuchi 1995).

Haldin-Herrgård (2004) presented a definition of tacit knowledge in her doctoral thesis: “Tacit knowledge is personal but can be shared by individuals collectively, abstract but expressible in other forms than verbalization, affecting the ability to act independent of activity and competence and obtained by experience.” The most common epitomes used on tacit knowledge in her studies were intuition, skills, opinions, know-how, beliefs, mental models and practical intelligence.

Tacit knowledge is closely attached to the actions and experience of individuals (Nonaka and Takeuchi 1995). The individual nature of tacit knowledge is also highlighted by Polanyi (1966.) Tacit knowledge is connected to culture (for example Polanyi 1966) and to different situations and time (Kreiner 2002, Koskinen 2001) Tacit knowledge has also a social nature (Linde 2001, Nonaka and Takeuchi 1995) and bodily nature that can be brought out with senses: tasting, touching, hearing and seeing (for example Blackler 1995, Polanyi 1966, Keso 1999). Intuition is also closely connected to tacit knowledge (Herbing et al 2000, Koskinen 2001).

Trust and sharing of tacit knowledge

According to Davenport and Prusak (1998) sharing of tacit knowledge requires trust. Trust can exist at an individual level or organisational level. At individual level trust exists through close working relationships between colleagues and at organisational level by creating encouraging and rewarding culture (Davenport and Prusak 1998). Ardichvili, Page and Wentling (2003) defined trust as one of the premises when sharing and using knowledge in virtual communities of practice. They also make a distinction between knowledge based and institution based trust. Knowledge based trust emerges on the basis of recurring social interactions between a trustor and a trustee.

Renzl (2006) emphasizes trust as one of the most important factors when sharing and documenting knowledge within and between teams in organisations. Her studies showed that especially trust in management affected knowledge sharing and improved knowledge documentations. Panteli and Sockalingam (2004) also highlight the meaning of trust in knowledge sharing in their studies of trust and conflict within virtual inter-organisational alliances. Li (2005) stated in her studies that trust and shared vision facilitate knowledge sharing.

Trust can be identified as one of the premises facilitating sharing of tacit knowledge. Trust is closely connected to interaction and examined as part of it. In Figure 1 trust is seen as one of the factors in interaction along with cooperation, relationships, atmosphere, attitudes, openness and power. The other factors, in addition to trust, also emerge in literature when discussing facilitating sharing of tacit knowledge. Cooperation and good relationships are essential when sharing tacit knowledge because it can only be shared in face-to-face interaction (Holthouse 1998, Leonard and Sensiper 1998.) A positive atmosphere and openness are also recognized as factors in tacit knowledge sharing (Viitala 2005.) The attitudes of parties sharing
knowledge also play an important role (Virtainlahti forthcoming). Power has been brought forth in many writings (for example Kesö 1999) as one of the factors influencing the process of sharing tacit knowledge. Experts may keep their tacit knowledge as a “secret weapon” to be used in certain situations against the other members of organisation (Gorman 2002.)

Trust as one of the premises in sharing tacit knowledge

Fig. 1. Trust as one of the premises in sharing tacit knowledge (Virtainlahti)

Background information on thematic group and collecting data

Background information on the thematic group

The demand for the work of thematic group has emerged from the situation in Finnish society. Aging work force highlights the importance of knowledge and competencies in work organisations. There is a growing concern about the disappearance of experience-based knowledge and competencies when aged employees retire during short term of time. When discussing this matter, the premises of sharing valuable tacit knowledge come forward. Trust can be defined as one of the most important premises in sharing tacit knowledge.

This issue also emerged in the working culture charting conducted earlier by Work life ability networks. Therefore the theme of trust and knowledge transfer was chosen as one subject matter when creating different thematic groups in the project of Work life ability networks. The work of the thematic group focuses on the complex subject of trust in context of knowledge transfer.

The thematic group of Knowledge Transfer and Trust started its work in 2006. There have been 11 meetings during the years 2006 – 2007. Meetings are arranged about every second month and each meeting takes about two hours. Participants of the thematic group are from different areas of business and public organisations. The average number of participants in one meeting is 10-12.

The aim of the thematic group is to recognise the basic elements and characteristics of knowledge sharing and trust. The work is based on exploiting the research results and on discussions in thematic group meetings. The aim of the thematic group is to form an instrument to evaluate, build and maintain trust in work organisations. In the work of the
thematic group trust is seen from the viewpoint of knowledge sharing.

Collecting and analysis of data

Data used in this article was gathered in thematic group meetings in years 2006-2007. The researcher carefully wrote notes on each thematic group meeting. There was also an assistant in each meeting to keep the formal minutes of the meeting. Both types of data have been used as a basis of the summary presented in this paper.

The discussions in the meetings approached the theme of trust and knowledge sharing from different viewpoints. The discussions formed a process in which the theme was carefully analysed. The understanding and knowledge of all participants about the theme have increased during this process.

For this article the data was read through several times and analysed from the viewpoint of the aims of this article. The data were categorized. The result presented in this paper is a outlined summary of discussions.

The outline of the thematic group work

This part of the article presents the outline of discussions in the thematic group on trust as a concept and as one of the premises of knowledge sharing. The discussion on the concept is presented first, to be followed by an introduction of the instrument for building and maintaining trust in work organisations. The data from discussions is presented as an outlined summary collected in several thematic group meetings. Therefore the thoughts are not separated according to speakers.

Trust – Discussion on the concept

The thematic group became aware early in the discussions that trust is difficult or even impossible to approach alone, and therefore it was linked as a part of interaction. The thematic group defined interaction as dealing between people, which can emerge as speech or action and behaviour. Interaction was seen reciprocal. It was also recognized that interaction may be unilateral, for example from superior to employee, if the speaker’s authority is sufficient. Thematic group defined openness and honesty as fundamental factors affecting in the background of trust.

Openness operates as a gateway to build trust. Openness is manifested in the transparency of matters. Right and relevant information flows to appropriate people. Openness also includes certain limitations. For example, in development discussion the parties may trust that the conversations stay only between those present and they are not discussed afterwards behind one’s back. Openness and trust emerge also in other discussions in work community. Essential about these conversations is the right information for the right people. Also being genuinely present in the conversation situation is important. When discussing openness it is also important to recognise openness related to the subject. Openness at the workplace does not mean that one has to reveal one’s personal life to the colleagues. Openness also includes a possible threat. When you are open about matters you must dissemble part of your defence. This may cause problems if the opposite person has an interest in causing trouble. Being open therefore demands trust, in order for people to be able to give up defences.

In the thematic group trust was seen in little everyday actions that the other party regarded
as positive. Trust can also be seen as a sort of evaluation situation. Management is assumed to operate in a certain way in an organisation. There are certain matters where management is not allowed to fail in order to maintain trust. Knowledge must flow openly, even though there also may be justifiable matters under concealment. It is important to inform the employees about these matters and grounds for concealment. Employees of the organisation also evaluate the future of their job and the organisation: do we trust on continuance and the future, are situations at workplace predictable. Personal characteristics play an important role when evaluating trust. Someone feels that I am reliable and therefore my subordinates must trust me. Different things create trust in different people. Evaluating trust also relates to a changing amount of trust. It can change over the time, for example in the beginning of the employment the amount of trust may be low but it may increase over time, or vice versa. Even in the same organisation the atmosphere of trust and the amount of trust may be different between departments.

Trust can also be examined from the viewpoint of competence. Am I competent, am I able to do the right things right way? Am I recognized by management as a competent and skilful employee, am I a believable and wanted employee? Do I recognize my own competence and value it as well as competence of others in the work community. Trust is also a basis for developing work skills. Trust is an important factor when the withholding of knowledge is to be avoided. You may not share your knowledge if you are afraid that your own position in the organisation will change for the worse. Many people feel that withholding is a trump card to maintain your special position.

Trust from the viewpoint of competence is displayed in the situation of delegating. What is delegated and to whom? Do we know the other person’s work well enough, do we trust his/hers competence and ability to finish the job in given time? It is also important to notice if the person has adequate responsibility and power to execute given task in practise.

Mistakes and errors done at work are the situations where the level of trust is tested in practice. Recognizing and reporting one’s own or someone else’s error indicates the atmosphere of trust in the work organisation. Fear of negative consequences may prevent even serious errors from being exposed, even though repairing them would be essential for the process. Trust in colleagues and organisation helps bringing forth errors. Responsibility and carefulness also have and influence in the background.

To summarize the work and discussions of the thematic group, Figure 2 illustrates the basic ideas of the thematic group work.
The instrument of building and maintaining trust in a work organisation

The main aim of the thematic group was to formulate an instrument for building and maintaining trust in work organisations. The instrument is considered a basic tool to help the members of organisation to evaluate, build and maintain trust. The thematic group approached the subject in the beginning by defining issues that are harmful or counterproductive when building or maintaining trust. At the moment the instrument is at a stage where the important areas have been determined and the context of these areas has been discussed. This article introduces context of this instrument in the state of current situation. The development work still continues.

The instrument of building and maintaining trust includes four segments: interaction and trust, competence and trust, predictability of trust, and organisation culture and trust. Each segment is briefly introduced in the following.

Interaction and trust
As defined in the previous chapter, trust can be examined through interaction. In the atmosphere of trust interaction functions inside and outside the organization, there is togetherness in the organization where employees support one another. There is also a state of fairness, equality and understanding of diversity as well as flexibility and loyalty. The members of organization also feel free to express their thoughts. In the background of interaction there is an important factor of transparency and openness which prevents disloyal behaviour and cover-ups.

Competence and trust
Trust in the context of competence includes recognizing and valuing one’s own competence and the competencies of others. From the individual point of view the level of trust can be examined through professional self-respect and individuals’ knowledge and skills. These are
also closely connected to sharing of knowledge and competence with other members of the organisation. From a wider point of view trust can be recognized in empowering and delegating situations.

**Predictability and trust**

The area of predictability and trust includes transparency as an important factor. Transparency enables employees to predict the future of the organisation and their position in it. Predictability can be destroyed if decisions and actions are in conflict, there are empty and uncovered promises or a situation of indecision. Turnover of staff and management with unclear reasons weakens predictability. Steady operation methods and instructions, target-oriented behaviour and feedback systems encourage atmosphere of trust.

**Organisation culture and trust**

Organisation culture influences the atmosphere of trust significantly. It is a complex issue, and in the work of the thematic group it was considered from a broader point of view. Organisation cultures differ from one organisation to another but there are some kinds of common features in organisations in the same line of business, for example comparing the marketing companies against the forest industry companies. When examining organisation cultures from wider point of view there is also a danger of stumbling on stereotypes and beliefs. Macro level factors also change in time.

**The levels of examinations**

The four areas of trust in the instrument can also been discussed at different levels: individual, group, organization and society level. Figure 3 illustrates the instrument of trust and different levels. The area of competence can be considered an individual level. The competencies in the organisation are embedded in members of organization, in individuals. Competencies are used and shared in interaction at group level. Predictability is mainly based on actions and decisions made by superiors and management and therefore it can be examined from the organisation level point of view. The influence of organisation culture shows at the organisation level. Society level influences all areas on the table. If the situation in society is difficult, for example recession and laying off people in great numbers in many organizations, the balance between the areas can be affected. Individuals consider very carefully whether they should share their knowledge and skills in fear of losing their job, and there is a great risk of knowledge withholding. On the interaction level the situation may cause, for example, secrecy and lack of togetherness. Predictability decreases when the business environment is under change, even if the situation in the organisation is steady. The general situation raises doubts.
The instrument of building and maintaining trust
The areas and levels of examination

Society level

Interaction and trust
Predictability and trust

Group level

Prediction and trust

Organisation level

Competence and trust
Organisation culture and trust

Individual level

Fig. 3. The instrument of building and maintaining trust. The areas and levels of examination.

Conclusion and discussion

The aim of this paper was to examine the concept of trust both in literature and as thoughts of the thematic group of Knowledge Transfer and Trust. The second aim was to introduce the instrument of building and maintaining trust in work organisations developed by thematic group.

To summarize the discussions on trust in the thematic group, it may be stated that trust is easier to examine in connection with, for example, the interaction process than as a separate factor in work organisations. The thematic group defined openness and honesty as a gateway to trust, which makes it easier for essential matters to become transparent in work organisations. Trust was considered as small positive actions. It can be examined as evaluation situations done by person partly subconsciously and partly consciously. The amount of trust may vary during the employment and also in different departments of the organisation. From the competence point of view trust often emerges as valuing competence in one’s own work and also valuing other people’s competencies. One of the test situations of trust in the work organisation are the error situations and recognizing and reporting them. Trust cannot be examined through only one element but all elements are needed in confidential atmosphere.

Researchers have also approached the concept of trust from the same kind of viewpoints. For example in Blomqvist’s (1997) article the researchers from different disciplines also regarded trust as a positive action and recognized its unconscious and reciprocal nature (Blomqvist 1997, Ilmonen 2000) Trust was also associated with cooperation and interaction. This was highlighted especially in discussions on social capital (Mäkelä and Ruokonen 2005, Mäkipeska and Niemelä 2000) and capital of trust (Harisalo and Miettinen 1995). The competence point of view also appeared, for example, in Blomqvist’s (1997) article as an expectation of the other party’s competence. The discussions in the thematic group on the concept of trust reflected the general discussion on trust in literature despite the thematic group’s background, interests and objectives. The same elements are found in other writings.
The main objective of the thematic group was to formulate an instrument for building and maintaining trust in the work organisation. The thematic group defined four areas for the instrument: interaction and trust, competence and trust, predictability and trust, and organisation culture and trust. Each of these areas approaches the subject from a different viewpoint. Examination has also different levels: individual, group, organisation and society level. Different levels enable in-depth examination from the viewpoint of areas in the instrument. A Centre for Occupational Safety publication introduces very similar areas of building trust (original reference Reina and Reina 1999). The areas include trust in professional skills, trust in interaction and basic trust. Trust in professional skills focuses in competencies, skills and abilities of people, involving and empowering and learning new skills. Trust in interaction includes good flow of information, reliable discussions, reporting errors, giving and receiving feedback. Basic trust refers to trust of things turning out right. It includes defining boundaries, delegating, keeping agreements and being consistent (The Centre for Occupational Safety 2006). These areas of building trust are very similar to the one formulated by the thematic group and therefore confirms the essence of them as fundamental factors to be included in the instrument of building and maintaining trust.

Examination from the point of view of different levels has also been emphasized in other writings. Davenport and Prusak (1998) define individual and organisational level trust. Ardichvili et al (2003) on the other hand make a distinction between knowledge-based and institution-based trust. In the instrument for building and maintaining trust levels are divided into general and detailed levels: individual, group, organisational and society level, which all are justifiable point of views to the subject.

As a whole the result of thematic group work, an instrument for building and maintaining trust, can be explained based on scientific discussion, even though the aim has been to formulate an instrument to be utilized in practice. At the moment the instrument is still in the process of development. There is still incompleteness in defining the process of building and maintaining trust. The key areas are recognized and justified. When the instrument is finished, test projects in practice will show its usability.

For future studies, it would be useful to consider how trust is measured. Is it an on/off state or how the amount of trust can be defined or measured? As a starting point, when does trust originally emerge? In connection with this problem, how can trust be restored if it has been lost. These questions are important when formulating a comprehensive instrument to build and maintain trust.

The viewpoint of the thematic group has been to examine building and maintaining trust from the knowledge sharing perspective. For future actions it is also important to connect these processes. It cannot be assumed that trust by definition automatically generates knowledge sharing. Other premises also need to be recognised and the overall process formed in order to facilitate knowledge sharing.

The participants of the thematic group represented various backgrounds, the public and the private sector, occupational organisations, both long experience and work careers as well as younger, less experienced participants. The level of expertise in the thematic group can be considered high. The instrument formulated by the thematic group represents the group members’ individual and collective views over the subject matter. The instrument, when finished, is designated to be utilised by all parties interested.
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References

Finland, pp 21-44
The Centre for Occupational Safety (2006) Kehittämisen kulmakivet Tuottavuus, luottamus, hyvinvointi. Kirjapaino Topnova Oy, Finland
Virtainlahti S (forthcoming) The premises and barriers in sharing tacit knowing
HEALTHY AND SUCCESSFUL WORKPLACE INDICATOR. A HOLISTIC TOOL FOR DEVELOPING WELLBEING AT WORK

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Abstract

Finland is about to experience extensive reduction of labour, because so called “baby boomers” are retiring from the labour market in the near future. Because of that it is essential to get workers to continue longer in the working life and attain a higher retirement age. Therefore, investing to the work organisation’s health issues is particularly necessary.

Unfortunately it is common that health issues of workplaces are mainly taken care by the organisations’ health services. It should not be that way, because health issues should be the interest of the whole organisation. Before health issues can be developed and improved, it is necessary that the management of organisations is committed to improve health issues and wellbeing at work. In the Development cycle of individual’s abilities in work organisation thematic group the target has been to formulate the HYMETY (HYvinvoiva ja MEnestyvä TYöpaikka, Healthy and successful workplace) indicator. The HYMETY indicator is meant to be a concrete instrument for the organisations’ management and it is intended to evaluate the level of wellbeing at the workplace. The other essential aim of the indicator is to determine the inputs that the organisation has invested in the wellbeing of the workplace but also to examine the results that the inputs have enabled.

The indicator is divided in three parts. In the first part, there is a large questionnaire about workers’ estimates of their own skills, atmosphere at the workplace, working conditions, workers’ resources, social relationships and interaction of the workplace, trust among workers and finally work and personal life. These themes are investigated by a defined set of multiple choice questions. The second part of the indicator is composed of questions that workers can answer in their own words. This part of the indicator can also be carried out by interviewing the organisation’s workers. The aim of these questions is to give deeper understanding of the themes that come out in the first part of the indicator. The third part of the indicator is a large interview to the organisation’s management. In this interview the purpose is to find out as deeply as possible how the organisation is working, but also to see what kind of investments it has made to repair its wellbeing.

After the data gathered by HYMETY is analysed, the situation of the workplace will be estimated. If there are any needs to improve the workplace, the improvements will be planned and carried out. An important objective of the HYMETY is also to find solutions to the workplaces’ wellbeing problems.

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Key words: HYMETY indicator – Worker – Work life - Wellbeing at work
Nowadays it is often said that wellbeing at work is already a thoroughly researched branch of science. Without question it is true that there are plenty of researches into wellbeing at work. But there are still many problems at working life and it is common that workers are tired and have many kinds of problems of wellbeing because of uncomfortable working situations or poor work atmosphere.

In The Promotion of Work Life Ability - Networks the wellbeing at work is still seen a very important thing in the working life, which need to be analyzed and developed. There are eight thematic groups in The Promotion of Work Life Ability - Networks and each thematic group has it’s own method to work on and develop. These methods can be utilized in work organizations when trying to improve the work conditions, knowledge, work life ability and wellbeing at work.

This article presents the work of the Development cycle of individual’s abilities in work organization thematic group. The thematic group has been working on to formulate a large indicator to analyze the level of the wellbeing at work organization and also evaluate the inputs the work organization has invested in the wellbeing at work and also the outputs that the inputs have enabled. The indicator is called HYMETY (HYvinvoiva ja MEnestyvä TYöpaikka) indicator. In English it means: a healthy and successful workplace.

By using this indicator, it is possible to reveal the connection between the wellbeing at work and organization’s success. The indicator also reveals concrete needs to develop in the field of wellbeing and work conditions.

This article is composed of three parts. First there are a few words about typical character of recent working life. Then text continues with wellbeing at work and finally presents the HYMETY indicator.

Last decades have seen many changes in the world, society and labor market. The labor market in Finland has also changed greatly. First of all there was deep recession in the 1990’s which caused expansive unemployment. The worst years were 1993 and 1994 because then there were some 500 000 jobless in Finland (Karisto et al 1998). After the recession Finland still suffered from structural unemployment with some 300 000 jobless. In 2008 the situation is slightly better while there are at the moment 155 000 jobless, which is 10 000 less than one year ago (Tilastokeskus 2008).

After recession working life also became more demanding for the workers. Those who were allowed to keep their jobs were forced to work under hard pressure, because now there were fewer workers and less resources but still more work to do. During the recession untypical jobs (part time job, fixed term jobs) also became a normal feature in the work world. The unemployment and untypical jobs made working life unsafe (Happonen 2000). Insecurity may cause disease-like occupational exhaustion.

Still, comparatively Finland is among the most advanced information societies in the world. There are great investments to education, research and product development. The products of information and communication technology form a major part of Finland’s exports (Jokinen 2002). The huge increase of information technology has changed Finnish working life substantially. A very big part of workers are now using information technology in their jobs. That, of course, has caused a lot of demands to the workers to update and maintain their skills and professional ability. Also, a considerable number of workers are now working as information workers. Instead of working on machines or instruments, information workers are
working with symbols and information, working in teams and producing services based on skills and knowledge. Consequently, intellectual resources have become one of the most important assets of the labor market (Otala 2005). A corollary of the great success of information technology seems to be discomfort factors in working life. They are manifested as conflicts at work communities, occupational exhaustion, depression, wishes to retire or otherwise escape from the working life (Julkunen 2006).

Changes in the labor market have been so sudden and intense that even traditional things such as education, no longer help to save the situation in working life. Education has lost its value as a security (Happonen et al 2000). Although education no longer ensures stability in the working life, it is an essential prerequisite of getting any job. For example, in 1960 only every sixth person had some occupational education. But already in 1985 half of workers had occupational education (Nätti 1998).

In addition these changes in the working life, Finland is also about to experience an extensive reduction of labour because the so-called “baby boomers” are retiring from the labour market in the near future. After year 2010 the number of working people will turn to a decline and at the latest year 2030 is estimated to decline even by 400 000 people. That is a considerable number in a country with only five million inhabitants. The ageing of population is not happening only in Finland but in many other countries, too. But the change is particularly drastic in Finland because the ageing of population happens so fast (Otala et al 2005).

The ageing of population is so speedy in Finland that it will pose a big challenge to Finland’s economy and social policy because of the increasing payments of pensions and elderly care. It is essential to maintain and improve workers wellbeing and competence to avoid too many early retirements or disability pensions in a situation where there are fewer and fewer workers at the labour market. In that kind of situation it is even more important to keep the working ability and competence of workers on a good level and assure that work organisations invest in the workers’ health and wellbeing (Otala et al 2005). Even though it is nowadays often said that there is already too much research in the field of wellbeing at work, there are still many wellbeing problems at workplaces. For this reason wellbeing at work is still perceived as one of the main focuses of The Promotion of Work Life Ability - Networks.

There are many ways to define the term wellbeing. One is to define it by Maslow's hierarchy of needs. On the first level on that hierarchy are physiological needs like proper nourishment, drink and adequate rest. When reflecting this hierarchy on wellbeing at work, that can be compared to the worker's health and physical condition because these are the basic elements of wellbeing at work. The second level in the hierarchy are safety needs, which in working life means that workers need a safe working environment and a feeling that their work community is secure and they can keep their jobs. The third level in the hierarchy is love and belonglines needs. In the working life it means that workers want to feel that they are a member of their work community. When workers feel that they get support from the other members of the work community, it improves commitment and motivation to the work and also coping in job (Otala et al 2005).

The fourth level is self esteem needs, which in working life means skills and profession. The respect from work brings security which also supports social wellbeing. The fifth level is self actualization needs, which means that a worker wants to develop in his job, be creative and also reach goals. In the top of the hierarchy are intellectuality, values and ideals. These control people’s motivation and commitment to things. This level can be defined as mental wellbeing.
and it is very important, because wellbeing derives from one's willingness, own values and ideals. No improvements help if you do not want protect your wellbeing yourself. If mental wellbeing is not in proper condition, it also causes problems to the other levels of hierarchy (Otala et al 2005).

Fig.1. Wellbeing at work illustrated by Maslow's hierarchy of needs

In the Promotion of Work Life Ability - Networks wellbeing at work is called experienced wellbeing at work. It means that the wellbeing at work is a personal holistic estimate, expression or awareness of how he is feeling his own condition. Various factors and their mutual combinations can affect on to the experienced wellbeing at work. The experienced wellbeing at work can also differ strongly depending on time, place or situation. In addition, personal life and life outside the work also affect strongly the experienced wellbeing at work (The Promotion of Work Life Ability - Networks, see The Handbook of Work Life Ability 2008).

The experienced wellbeing at work is composed of five parts; management, ability, motivation, work community and healthiness, and healthy workplace. But besides these there is also one very particular element to the wellbeing at work: trust.

Management is a very important factor to the wellbeing because it enables foundations and possibilities for both working and improving wellbeing. Management should be carried out in a responsible way and respecting people's dissimilarity. Workers' ability is also important to the wellbeing, because it has to be up-to-date and work instructions also have to be clear. A positive attitude towards development, recognition of development and sharing of knowledge all improve wellbeing. Motivation is also one the basic factors to wellbeing. Motivation arises from commitment to work and work organisation but also from experiences of success. Maintaining of motivation demands useful and stimulating feedback from work, but also justice and possibilities to have a say in one's own work and issues related to the work
community. The work community is the next element important to wellbeing. A good work community supports possibilities to do one's own work, and interaction between members of the work community needs to be open. It is important to remember that every single person in the work community is responsible for the work place's atmosphere, and if there are any conflicts between workers, they have to been recognized and solved (The Promotion of Work Life Ability - Networks 2008).

In addition to these it is important that there is a healthy and safe work environment in the work place. It helps improve the healthiness and wellbeing of personnel. Finally, wellbeing is grounded in trust in the workplace. If there is trust between workers, also communication is active and the atmosphere is open and negotiable. When there is trust in the work place, workers dare to be creative and innovative. Then also the results of the work become better. (The Promotion of Work Life Ability - Networks 2008.)

Fig.2. The factors of the wellbeing illustrated by The Promotion of Work Life Ability - Networks

The meaning of wellbeing at work should never be underestimated, because healthy personnel can adapt better to the changes in the working life and meet new challenges at work better. Healthy personnel is successful and cope well with the work but also during leisure time. Investment in wellbeing is positively connected to the work organization’s economical success, because of savings in staff expenditure (like costs of pensions and sick leaves).

All in all, wellbeing at work means a work community which offers challenges, safety, success and possibilities to develop at work. Wellbeing at work includes much more than just health care, and it is absolutely not enough to organize just one relaxation day for personnel in a year. Wellbeing at work is one of the most important factors for work organization's business strategy because it has a huge effect on its success and result (see The Handbook of Work Life Ability 2008).

A good and healthy organization
A good and well-working organisation has such features that improve personnel's wellbeing, coping with work and also productiveness of work. The good organisation can also survive
changes of business environment and will also be able to maintain its productivity and capacity to promote health and wellbeing at work (Simola et al 2005).

There are some things that such organization should have if it is to take proper care of the personnel's wellbeing. First of all, the good organization has good occupational health services for employees and also other services that support personnel's wellbeing (such as a catering service at work). It also invests in the work safety and has safe working models. Such work organization also has an objective, equal, supporting and inspiring work atmosphere. Employees are also respected and they have possibilities to affect to their own work (Rauramo 2004).

The good organization also enables its employees to learn and develop themselves at work and ensures that tacit knowledge and skills of different workers are also utilized. Such organizations also have proper ways and forms to reward and support employees (Rauramo 2004), which is a very important factor to keep workers’ motivation on a high level.

As shown in the above figure, knowledge and skills are a competitive advantage for the work organisation, when skills and ability of different workers are utilized and different abilities and skills are shared and networked with other workers. The utilization of tacit knowledge is also necessary, but it requires such conditions and atmosphere where workers are likely to share knowledge. The wellbeing of the work community includes all factors which
support wellbeing. These include workers health services, job safety, recreational activity, sport, catering service and a comfortable work environment. Working tools, information systems and the working process are also important (Otala et al 2005).

It depends on management system of the workplace how the wellbeing issues are realised. Management has a direct effect on workers’ motivation, commitment to the work and their ability to utilize their resources. Management has a huge impact on workers wellbeing. In the background of the work community’s operations are values. Wellbeing of the workplace is based on values which direct the organisation’s improvements and targets of managements. On the other hand, the workers own values and values of the workplace have to be similar. If there is conflict between own values and work organisations values it will cause problems to the wellbeing. Maintaining of the wellbeing is a challenge for both to the management and also to the workers. Management cannot alone be in charge on anyone’s wellbeing (Otala et al 2005).

The thematic group Development cycle of individual’s abilities in work organisation is one the working groups in The Promotion of Work Life Ability Networks. The group is composed of experts on many fields and they are co-operation partners of The Promotion of Work Life Ability - Networks. Even though there have been experts from various careers and different work organisations, they have still had one common motive: they all have been very interested in wellbeing at work and they have had appeal to improve wellbeing.

The thematic group has worked since October 2005. During the first year the members of the thematic group met at least once a month. There was a coordinator in charge and the coordinator had the main liability to work with an indicator. First, the coordinator made a draft plan of the indicator and then it was presented in the meeting of the thematic group. In the meetings there were active discussions about the indicator and the members told their opinions of how to work on and improve the indicator. Between the meetings the coordinator worked on with it and always presented a revised version of the indicator in the next meeting.

In winter 2007, there was the first pilot evaluation in work organisations. It was just test and after it, there was still lot of work in the thematic group to work on with the indicator. In spring 2008 there were again pilot evaluations in two work organisations. After all pilots, the work organisations and their personnel were able to give a feedback of the evaluation progress and about the HYMETY indicator. The indicator was further worked on and developed according to the feedback.

The HYMETY project is divided in three parts. First of all there has been an extensive theoretical study on Finnish working life and recent studies of wellbeing at work. Its purpose was to estimate and design a new indicator to evaluate the wellbeing at work.

After that there The Promotion of Work Life Ability - Networks has worked on composing and testing the HYMETY indicator. After the testing, feedback was gathered about the indicator in work organizations. The third step would be to work on with a guide book. It would contain instructions on how to use and apply the HYMETY indicator. There would be help on how to analyse data collected by HYMETY and also tips on how to process the results in the work place. Unfortunately the project, The Promotion of Work Life Ability - Networks, has ended and it is not yet known how and when the guide book will be produced.

The HYMETY indicator

A result of the thematic group’s work is a large indicator, which is meant to be a concrete
measure for the work organizations. The indicator is composed of three parts. First, there is a large questionnaire about wellbeing at work. This part of the indicator is meant to be used by the whole personnel. The results of this part will be analyzed both at organizational level but also at small units of the workplace.

After this, if there are some units in the work organization which differ from the other units or of the whole organization, there will be a second survey, which attempts to deepen the results of the first evaluation. This second part can be done by a questionnaire or interviews.

The third part of the indicator is an interview to the work organization’s management. The purpose of this interview to determine the organization’s operating principles and also to find out what kind of inputs organization has used to enhance wellbeing at work, and what kind of results these inputs have enabled.

The objective is to find out meaningful targets for the workplace to develop: in other words some concrete issues that are easy to realize. It is important to ensure that there are not too many targets to develop at the same time. It is usually best solution to choose only one target at a time. When the first target is achieved and solved, it is justified to choose another one and work with it.
### Sectors of Indicators

#### INPUTS:

1. **THE FOUNDATION OF THE ORGANISATION**
   - 1. Organisations’ ideological and judicial foundation
   - 2. Personnel strategy

2. **HUMAN RESOURCE MANAGEMENT**
   - 1. Recruiting
   - 2. Equality
   - 3. Management and communication in organisation
   - 4. Organizing of work
   - 5. Control system of working times
   - 6. Rewarding and motivating of personnel
   - 7. Developing of personnel
   - 8. Organisation’s internal communication
   - 9. Employer–employee co-operation
   - 10. Employment issues
   - 11. Work environment, safety and health at work, occupational health care
   - 12. Coordination of work and personal life
   - 13. Services supporting wellbeing at work

#### OUTPUTS:

1. **THE OUTPUTS OF HUMAN RESOURCE MANAGEMENT**
   - 1. Exchange of personnel
   - 2. Occupational accidents
   - 3. Distribution of personnel’s working time
   - 4. Sick leaves
   - 5. Disability pensions
   - 6. Retirements
   - 8. Workers’ skills
   - 9. Success of teamwork
   - 10. Equality
   - 11. Productivity

2. **PERSONNEL’S WELLBEING**

3. **CUSTOMER SATISFACTION**

4. **ORGANISATION’S SUCCESS**

5. **TRUST IN ORGANISATION**

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As said above, the HYMETY indicator is meant as a concrete measure for the work organisation’s management. But the starting point of this HYMETY project was that at the first stage the use of the indicator and analysis of the data collected by HYMETY is carried out as co-operation between the work organisation and the experts of The Promotion of Work Life Ability - Networks. This first analysing of the work organisation’s situation is meant to be a large HYMETY measurement where all the parts of the indicator are used and applied. In other words, the first part is the questionnaire about wellbeing at work, while the second wellbeing survey (questionnaire or interview) deepens the results of the first survey. And the third part is the interview to the management of the organisation.

It is planned that those organisations which achieve a particular score in the analysis will get a HYMETY diploma. After this first HYMETY analysis the organisation will get its own HYMETY indicator. This indicator will be a limited version of the large HYMETY indicator. The work organisation will also get a comprehensive guide on how to use the indicator independently.

Improving wellbeing at work requires strong commitment of the organization’s management,
but it has to be done in co-operation between the management and the personnel. Nevertheless, the organization’s management plays a key role in both developing and also maintaining the wellbeing at work. The management enables the settings for working and thus also the settings to improve wellbeing. It is the management’s task to address resources – time and money – for the development. The management also needs to be a role model to the whole personnel in how to behave so as to improve wellbeing. Everyone is in charge of developing wellbeing. Everyone has to make an effort for his part.

When an organization’s personnel is healthy, it is successful at work and able to do its work properly. The work of skilled, motivated and healthy personnel produces high quality results. The personnel will also be able to continue longer at work without any disabilities or early retirement. On a large scale, improving the working conditions and the wellbeing also has a positive impact in the whole national economy.

Hopefully the HYMETY project presented here will be somehow concluded and the testing of the indicator finished in the near future. The writing of the guidebook should also be finished to allow the indicator to be used and applied in work organizations. When the HYMETY project will be finished, hopefully the indicator will prove a good method for its part to improve wellbeing and work conditions and will be utilized widely in various work organizations.

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References


Otala L, Ahonen G (2005) Työhyvinvointi tuloksentekijänä. WSOYpro: Juva


WORKING CULTURE, LIFE MANAGEMENT AND WILLINGNESS TO CONTINUE WORKING. NEED TO REINVENT HOLISTIC TRAINING WORK SITES

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Abstract

Gaining in-depth knowledge of the structure and characteristics of working cultures has been a central task of the interdisciplinary network project The Promotion of Work Life Ability Networks, whose general objective is to improve work life ability in work societies and work organisations.

In accordance with this task, working cultures in workplaces and factors affecting them were studied by a working culture charting in the autumn of 2005. The study was conducted by means of a postal questionnaire targeted to governmental and municipal social, service and nursing organisations as well as private manufacturing enterprises. The response rate was 66 percent.

The results reveal that well-being experienced at work is a whole half of which is composed of the working culture at the workplace and half of own life management. The functionality of working cultures depends largely on interaction in the working community. Working culture is the result of many interrelated factors, such as the operation of the organisation, management communication, mutual interaction of personnel, social working conditions and trust in organisation.

The prevailing working culture either repels people or promotes their commitment to the work. Working culture reflects the level of work life ability in the work societies and organisations. Working culture and life management play different roles in people’s willingness to continue working at different ages and stages of life. Among employees under 40 years of age, willingness to go on working depends essentially on the working culture, while own life management plays a more central role among the 40 plus age group and especially among women. Women experience satisfaction with both the working culture and their own life more often than men. Men, on the other hand, form the majority of the group that is dissatisfied with both the working culture and their own life management.

Due to the skewing of our population structure and diminishing labour it is important to take good care of currently employed people. Maintaining the well-being of employed people requires above all a new kind of interdisciplinary qualitative development of work organisations. According to our results, a functional and interactive working culture plays a particularly decisive role with a view to the correct use of skilled labour, utilisation of expertise, work ability and willingness to continue working.

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Key words: Work life ability – Work culture – Life management – Willingness to continue working
Introduction

Work Life Ability Networks

As a result of basic survey and collecting work, which took nearly for two years, two interactively working interdisciplinary and multiform network organizations have been built in Finland: one is the *Learning Network* and the other is the *Enterprise Network*. These interactively working networks concentrate on the improvement of work life ability in work organizations in a proactive way.

Eight thematic and expert groups play a central role in initiating developmental projects in enterprises and work organizations. The thematic and expert groups working in connection with the network organisation are channels through which people can participate in elaborating issues essential for the development of their own work and working communities. The thematic and expert groups are mixed groups that focus on studying and learning from everyday work and activities, stopping to think and contemplate on these activities, building a common framework of interests, and implementing agreed actions and projects in cooperation with others. The work of each thematic group is assisted and coordinated by a coordinator in charge.

The thematic and expert groups of the networks are: Information production, Productivity and interactive working and living conditions, Foresight knowledge and needs of skills in the work organization, Skills development during individual work life careers, Knowledge transfer and trust in the work organization, Safety management, Work time training linking individuals and work organizations, and Training and study of work life abilities.

The networks will connect the various parties representing skills and expertise of working life in an innovative way (“Clover leaf”). There has never been any corresponding co-operation between the actors.

In the coming years, as a result of a networked operation, a stable both nationally and internationally networked organization for coordination will be built up. With the support of its coordinative programming work, future practice-oriented operation, originating from enterprise and working life, will be programmed and developed further, and new developmental programs will be established. The image of the network is *Partner for promoting work life ability*.

A general target of the networks is to test and search developmental models, where the functionality of working societies and working organizations is firmly involved in the development of work itself, where the personnel itself take initiative and responsibility for development, and which enables learning of the work organization, enables getting profits out of this advanced work life ability as well as the birth of a new positive, trustful and encouraging working culture inside work organizations. The network’s slogan is “Skilled people create success”.

Material and Methods

The structure and characteristics of working cultures is one of the central tasks of the interdisciplinary Promotion of Work Life Ability Networks, whose general objective is to improve work life ability in work organisations.

In accordance with this task, an extensive study was made in the autumn of 2005 by means of a postal questionnaire targeted to governmental and municipal social, service and nursing
organisations as well as private manufacturing enterprises. The response rate was 66 percent.

Similar comprehensive studies are to be repeated in a similar way and in the same enterprises late in 2007 and early in 2008.

Interactive action research in the network

With a view to the implementation and desired effects of the development projects it is essential to know the working culture of the organisation in advance. The working culture charting conducted in the autumn of 2005 is a key part of the interactive cooperation between the member companies and experts of the network.

Stages of the interactive action research

At the first stage network actors are summoned who will then assess and coordinate cooperation. At this stage analyses of needs are made.

At the second stage future development measures are planned and recorded, after which the working culture charting is implemented.

At the third stage feedback on the results of the working culture charting is given and development measures are revised, and finally some more in-depth analyses are made.

The fourth stage consists of utilization of results and organization of training. The realization of the development projects is also assessed together. The development work continues with follow-up and new investigations.

Working culture

A working culture charting assessed working cultures based on 53 propositions measuring different properties. The scores of responses to these propositions were used for calculating a combined sum variable, the so-called working culture index, and combined working culture sub-indices. Working culture index, and combined working culture sub-indices characterise the following five areas of working culture: Operation of the organization, Management communication, Interaction of personnel, Social working conditions, and Trust in work organization.

Life management

In the charting subjects were asked to assess their own life management. Life management was assessed by a Life management index calculated from different areas of life. The assessed areas were Health status, Employment situation, Mental balance, Family life, Other human relations, Financial situation, Dwelling, Leisure time, and Life in general.

Subjective age

The respondents to the work culture charting were also asked to indicate their subjective age, that is, their own estimation of their age, in addition to their chronological age.

The subjective age is assumed to act as a general index that indicates either the vitality and energy or fatigue and wear of a person and so, reflects experienced well-being, health and social interaction. Subjective age is inherent to each one of us. Information on subjective age is useful, for instance, when considering preventive measures against the loss of ability and well-
Stressfulness of work

The respondents divided into two distinct groups based on the physical and mental stressfulness of their work.

Estimates of continuing to work

Estimates of continuing to work are examined in relation to the combined variables of working culture and life management. The research sought to find out how working culture and life management correlate with willingness to continue working in groups based on gender, age and occupational position.

Results

The average of Working culture index scores among employees in different positions varies between 333 and 375. Subjective experiences of the working culture improve towards the highest positions of the work organization in the following way:

- Managerial positions: 375
- Supervisory positions: 364
- Expert positions: 350
- White collar positions: 336
- Blue collar positions: 333

Out of all respondents to the work culture charting, 12.8 % (n = 329) assessed both the working culture of their workplace and their own life management poor. Correspondingly, 12.9 % (n = 332) of all respondents assessed both the working culture of their workplace and their own life management good.

The average of Life management index scores among respondents in different positions varied between 65 and 68. The lowest perceptions of life management were found among people in expert positions. Life management varied as follows between different positions:

- Managerial positions: 68
- Supervisory positions: 67
- Expert positions: 65
- White collar positions: 68
- Blue collar positions: 67

Regarding life management in different work organisations, the average of the Life management index score varied between 63 and 69 among women. Among men, in turn, the average of Life management index score varied between 61 and 66. In other words, women perceived their life management better than men.

About a quarter of the youngest men and women felt themselves 5 years younger than their chronological age. Among men and women of other age groups, 32 to 42 percent felt
themselves 5 years younger than their chronological age. With the exception of the youngest age group, the shares of respondents who felt themselves 10 years younger than their chronological age varied between 13 to 20 percent among women and between 18 to 21 percent among men. Less than half (47 %) of all respondents (n=2433) felt themselves as old as their chronological age.

Willingness to continue working increased with age. Among the youngest age group, 39 % of women and 30 % of men expected to continue working until the age of 60 to 64 years. Among the oldest age group, 70 % of women and 65 % of men estimated to continue working until the age of 60 to 64. Irrespective of age, almost all male and female respondents in managerial, supervisory, expert and white collar positions saw easing up their mental workload a necessary means to promote their willingness to continue working.

On the other hand, most respondents in blue collar positions, both male and female, regarded the reduction of their physical workload as a key means to promote their willingness to continue working.

The oldest respondents in blue collar positions considered the reduction of their physical workload necessary more often than younger respondents.

Extending the estimated time to continue working from the target level of 55 years to 60 years reduced the share of those who intended to continue working by 36 percentage points (81 to 45 %). However, the share of those who intended to keep working until 60 or older decreased by 20 percentage points among those respondents 40 or younger who perceived the working culture of their workplace good despite their own poor life management.

Worth noting is the intention of younger respondents to retire before 60. Another interesting finding is the strong role of the working culture in young respondents’ estimates of continuing to work.

Extending the estimated time to continue working from the target level of 55 years to 60 years reduced the number of those who intend to continue working by 32 percentage points (94 to 62 %). The share of those who intended to keep working decreased least among those respondents who reported a good life management combined with a good working culture of the workplace.

Respondents in white collar positions (management, supervision, expert and office) intended to continue working until 60 years of age or later more often than those in blue collar positions.

The results reveal that well-being experienced at work is a whole half of which is composed of the working culture at the workplace and half of own life management. The functionality of working cultures depends largely on interaction in the working community. The prevailing working culture either repels people or promotes their commitment to the work.

The better the trust in an organisation and the smoother interaction, the better the flow of information between individuals and the better the utilisation of the experience and expertise of employees is.

People generally felt that the familiarisation of new workers is the more successful, the better the relations between the management and the employees. In particular managers and supervisors stressed the role of human relations in familiarisation.

Both physical and mental stressfulness of work is common at workplaces. To ease up the workload at workplaces it is necessary to consider present dimensioning of labour, organisation of work, contents of work tasks, doing things together, utilisation of best practices
and conventions related to work, learning of interactive skills, and possibilities to improve the ergonomics of work and work cells and promote a more active use of various aids and tools in the performance of work. It is also important to learn to anticipate the sufficiency and skills of personnel.

A majority of the respondents thought that developing the wage system is the best way to encourage people to continue working. Besides the wage system, young women saw work-time training as the best means while older women saw the reduction of either the physical or the mental workload as the best means to postpone retirement. Work-time training was also seen as the best means by men with the exception of the oldest age group who saw the development of the working community as a key to promoting people’s willingness to continue working.

The results of the working culture charting are an important contentual part of the diversified training that is currently being offered to personnel members at our cooperation partner organisations. With a view in particular to the results and success of workplace level activities, development should be linked to anticipated changes in business operations and the needs arising from it: ensuring the skills, well-being and high ability of personnel.

Acknowledgements

The authors wish to express their gratitude to Mr Seppo Siuro for proofreading the text. The networks themselves are part of the Finnish workplace development programme TYKES.
MULTIDISCIPLINARY FIELD AND LABORATORY STUDIES ON COMBINED ACTIONS AND COMBINED EFFECTS OF ENVIRONMENTAL FACTORS FOR THE PAST THREE DECADES

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Abstract

Studies on combined actions and combined effects of and interactions between chemical, physical, psychosocial, organizational and biological environmental factors have become more and more topical nowadays. For example, we are currently faced with a number of serious environmental problems such as global warming, destruction or random variation of the stratospheric ozone layer, serious acid rain, melting of polar ice fields, and rapid changes in atmospheric conditions. Simultaneously, partly due to the global economy, hectic and profound turmoils are taking place in the working life. It goes without saying that demands for correct and upgraded knowledge in this field increase greatly at work sites as the very result from new skill requirements and health issues related to new types of work, new ways of organizing work, new types of technologies and new types of chemicals. Considering all these work related phenomena it is very urgent to conduct such studies and gather such knowledge that is both relevant and helpful to fulfil these requirements and in this way ensure the well-being of society and individuals. Whether we are dealing with manmade work environment, living environment or natural conditions, recognizing and understanding the multidimensional and multi-factored phenomena underlying them requires not only correct statistical methods but also the ability to use them in the right way. The goal of complex environmental studies is to understand reality as a functional whole and to depict it just as it is at any given moment. Very often it is a question of the combinations of different individual environmental factors and their combined actions and effects, which may appear immediately or in the course of time, or remain latent. Time is a key factor in this kind of a holistic approach. The multidisciplinary information from field and laboratory studies accumulated during this time is periodically reviewed by the ICCEF in its conferences, which also summarize the key issues discussed at each conference. In the conclusion the author lists things he deems necessary for improving the reliability and generalizability of multidisciplinary complex research.


Key words: Combined actions – Combined effects – Multidisciplinary studies – Environmental factors – Work life ability

The purpose of this summary paper

Relevant literature in this field has been available since the early 1970s. The multidisciplinary information from field and laboratory studies accumulated for the past three decades is periodically reviewed by the ICCEF in its conferences, which also summarize the key issues
discussed at each conference.

Hopefully, this short summarizing article will be helpful and condense the main points in comprehensive literature. This extensive scientific material is the basis where we can rely on in future.

The set of international scientific meetings

On 22-25 September 1984 The First International Conference on Combined Effects of Environmental Factors was held in Tampere, Finland. During the last day of the conference, on 25 September 1984, a new international scientific organization was established to further research on the complex combined effects of environmental factors and to ensure continuing contact between researchers working in this field. The International Society for Complex Environmental Studies – ISCES society – came out. The very first ICCEF Conference marked the beginning of a new international cooperation. Since those days a number of international scientific events have been arranged.

The subsequent memorable ICCEF Conferences were held

in 1986 in Kanazawa (Japan)
in 1988 in Tampere
in 1990 in Baltimore (USA)
in 1992 in Saariselkä (Finnish Lapland)
in 1994 in Toyama (Japan)
in 1996 in Tampere
in 1998 in Baden (Wien, Austria)
in 2000 in Savonlinna (Finland)
in 2002 in Takatsuki (Japan)
in 2007 in Tampere (Finland)

Moreover, today we can recognize that not only us but many other scientific organizations are arranging special sessions or satellite meetings with a focus on the interactions between or combined effects of environmental factors.

With regard to this, many excellent presentations have been given and numerous qualified papers have been edited and published. In general, the publications are of particular scientific significance and contain a wide range of useful information on the problems researchers in our field are currently concerned with.

Study cases for the past three decades

In order to demonstrate the practical importance as well as essential need for further research concerning combined effects and combined actions of environmental factors some basic findings and research reports have been picked up by conferences involved. Moreover, the examples illustrate the versatile and multidisciplinary character of and tasks related to the research of combinations in the field and laboratories.
Manninen O:
Complimentary studies on human reactions to complex exposures
Numerous fairly comprehensive studies are available on the effects caused by separate physical or chemical phenomena occurring in the environment and varying in intensity, duration or spectrum. However, relatively few investigations have been made into the combined effects of noise and vibration, or for that matter, into similar physical or dissimilar physiochemical environmental factors.

Okada A, Kajikawa Y, Nohara S:
Combined effect of vibration and noise
The TTS of hearing caused by noise is enhanced by vibration. Simultaneous exposure to noise and vibration made the TTS more severe than either noise alone or vibration alone.

Dobrovolsky LA:
Interaction of two different factors and problems of hygienic standardization
Experts working for scientific bodies justly note the difficulties in generalizing the enormous amount of experimental data obtained with the help of various criteria, levels of exposure, methods and statistic models. At the same time, the necessity to carry out experiments with long-term combined exposure aimed at getting more informative data is stressed. Besides, we think that to further investigation on interaction of environmental factors in the course of their influence on organism, the quantitative estimation of the exposure type (summation, antagonism, synergism) as well as the determination of its statistic authenticity are very much to the point.

Hetu R, Phaneuf R, Marien C:
The need to widen the framework for the analysis of the relationship between hearing loss and the working environment
Based on known mechanisms of ototoxicity, it is suggested that potent nephrotoxic substances are strong toxic agents to the inner ear. Authors concluded that systematic investigations of potential ototoxic chemicals from the workplace should be conducted as it was done for the effects of drugs for which case studies showed damage to hearing.

Hamernik RP, Ahroon WA, Henderson D, Salvi RJ:
Interaction between continuous and impulse noise: Frequency effects
This paper reviews several animal experiments which illustrate how the energy frequency spectrum of an impulse noise influences the hearing loss resulting from a combination of impulse and continuous noise.

Sandover J, Porter CS:
A review of the effects of mixed environments on task performance
Many jobs involving exposure to mixed environments and work tasks are becoming more complex with information processing as an important factor. When investigating practical
situations or attempting to understand the effects of mixed environmental stressors one also has to consider the influence of training, fatigue and the strategy used to cope with task demands, as well as the possibility of physiological and subjective responses leading to changes in task performance.

ICCEF 88 Conference, 15-18 August Tampere, Finland

Dormolen van M, Hertog CAWM:  
Combined workload, methodological considerations on recent research
This paper deals with a number of methodological considerations concerning the analysis of combined workload and presents critical comments on the premises and methods of research on this subject.

Izmerov N:  
Combined effects of industrial and environmental factors: some aspects of methodology and practice  
In real conditions we have to deal with a multi-factorial effect. It is a combination of work and non-work exposures, physical and mental load, negative social consequences, bad habits and style of life, personal perceptibility. The mixture of these exposure elements may cause quite a number of diseases.

Sakurai Y, Matsubara N, Noguchi T, Horie G:  
Extension of an additive model of discomfort with the utilization of a data set and application in the field  
The combined environment of heterogeneous factors has been investigated, bearing in mind that there always exist several factors in a room. Since a scale specific to one factor would not express the total effect of several factors, a non-specific scale has been used.

ICCEF 90 Conference, September 30 – October 3, 1990 Baltimore, USA

Seeber A, Kiesswetter E:  
Combined exposure to organic solvents: subjective symptoms as important acute effects?  
Irritation of mouth, throat and nose, dizziness, numbness, tiredness and other symptoms are typical signs of solvent exposure. During the exposure to combined solvents, as contained in glues, sprays, varnishes or degreasers, an individual level of subjective symptoms appears and increases more or less significantly, and after cessation of the exposure theses symptoms decrease and disappear.

Heinrich U:  
On the significance of carbonaceous particles to the carcinogenic potency of inhaled exhaust emissions  
Exhaust gases from incomplete combustion of organic material like coal, oil, gas and the various derived products contain several substances known to be toxic and even carcinogenic to human after inhalation exposure. Recent inhalation experiments have shown that the lung tumor rate in rats exposed to various PAH containing atmospheres not only depends on the PAH concentration of the exhaust gas but to a great deal also on the composition of the PAH containing particle, on the dissolution of the particle in attached organs, the haltime and the cytotoxic effect of the carrier particle in the lung.
Bödeker W, Altenburger R, Faust M, Grimme LH:  
*Synopsis of concepts and models for the quantitative analysis of combination effects: From biometrics to ecotoxicology*

Concepts and models for the analysis of combination effects have been used with different scopes in various fields of research. In pharmacology and toxicology studies on combination effects are undertaken to prove combined action of substances to be in agreement with theories of agonist/antagonist receptor relationships and to deploy such knowledge for mode of action studies. In contrast, in epidemiology and ecotoxicology terms like synergism or antagonism are used as qualitative descriptors of combined effects aiming at risk assessment and regulatory activities.

Greco W, Unkelbach H-D, Pöch G, Sühnel J, Kundi M, Bödeker W:  
*Consensus on concepts and terminology for combined action assessment: The Saariselkä agreement*

A consensus was reached among authors regarding terminology and concepts for two-agent combined actions. Precondition is that both agents are effective individually.

Taniguchi N, Katoh T, Kasuya M, Kozuka H:  
*Combined effects of local air pollution on ring-width of sugi (Cryptomeria japonica)*

Combined effects of air pollution on increment growth of Sugi were studied by means of dendrochronology. Sugi samples were collected from Toyama Prefecture, on the Japan sea side of central Honshu, Japan. A clear reduction was observed with SRI (standardized ring index) value. Among the three kinds of air pollutants, i.e., sulfur oxides, nitrogen dioxide and oxidants, sulfur oxides were suggested to be the most critical factor on the increment growth of Sugi.

Teranishi H, Katoh T, Aoshima K, Kasuya M, Hagino S, Migita S:  
*Seasonal factors related to the mortality among Itai-itai disease patients (people exposed to cadmium in the environment)*

Itai-itai disease is a disorder caused by chronic environmental exposure to cadmium. The main manifestations are severe bone pain and renal dysfunction. Our results suggest that some seasonal factors such as rapid climatic changes and/or seasonal biological agents may affect the mortality of the patient with Itai-itai disease.

Segura TE:  
*The relevance of controllability and predictability of stressors in the assessment of occupational stress*

The possible variation in the incidence of the level of prediction and control of stressors on the exhibited stress by different populations of workers was studied. Data concerning information, controllability and predictability seem to indicate that these features play a role in occupational stress.

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ICCEF 1998 Conference, 19-23 September 1998 Baden (Vienna), Austria
Müller CH, Krüger H, Schiersz C:  
*Project Nemesis: Effects of electric and magnetic fields on people suffering from hypersensitivity to electricity*

The study evaluates positive effects of field-mitigation on the well-being of people claiming to be hypersensitive to electricity. The problem of electrical hypersensitivity (EHS) is mainly based on case studies and is therefore considered a subjective phenomenon: Subjects with alleged EHS claim that their health problems (i.e. headaches, dizziness, insomnia or skin symptoms) are caused by electromagnetic fields (EMF). Many other environmental influences may play a role in the development of EHS.

Manninen O:  
*Notes on complex environmental studies*

Real life situations are usually complex. There is an increasing awareness that humans are exposed either simultaneously or consecutively to a large number of similar or dissimilar factors from variety of external sources. Many studies dealing with everyday work situations have shown that certain work and environment related factors together may affect body functions differently than the same factors alone. As the phenomenon under study is complex and multifaceted, consideration is given to the methodological and cognitive difficulties and challenges that the work poses to the researchers. In the research of complex phenomena it is always useful for the researcher to ask him- or herself the questions: what kind of measurement is needed, and how, when, where, and why measurements will be performed.

ICCEF 2000 Conference, 26-29 August 2000 Savonlinna, Finland

Kasuya M, Aoshima K:  
*Review on the combined effects and actions of chemical and toxicological factors in Japan*

Numerous chemicals have been introduced in the general and occupational environment and studies of biological effects by combined exposure are required. With regard to this, combined effects induced by multiple chemical factors as organic solvents, heavy metals and gaseous substances are reviewed.

Kolmodin-Hedman B, Åhman M, Holmström M:  
*Nasal symptoms in farmers exposed to a complex occupational environment*

The purpose of this study was to assess upper airway problems among farmers. The study shows that the farmers had more allergens and, predominantly, irritants in their work environment. For short periods, levels of organic and dust during hay handling were high.

Nagano K, Horikoshi T:  
*New index of combined effect of temperature and noise on human comfort*

The study revealed the following results: auditory conditions affected significantly the thermal comfort and discomfort sensations as well as the noisy and quiet sensations, and thermal condition also affected the noisy and quiet sensations significantly. These results provided the fact that there exists a measurable interaction between the above-discomfort sensations affected with temperature and noise.

ICCEF 2002 Conference, 28 - 31 August 2002 Takatsuki, Osaka, Japan
Yang RSH:
The integration of computer modeling and experimental toxicology for the study of chemical mixtures and multiple stressors

Human exposure to chemicals is rarely, if ever, confined to a single compound. Therefore, the study of chemical mixture toxicology has gained a great deal of momentum in recent years.

Sawada A, Yoshida T, Oyabu T, Okada A, Takenaka K, Manninen O:
Purification effects of plants for indoor air pollution in a university hospital

There is much mental stress for humans in our present complex society. Plants have healing capabilities such as aromatherapy and phytoncide. Plants also ease stress in a work environment. Various kind of offensive odors are generated in hospitals that are actual work environments. It is strongly desired to reduce these offensive odors. Furthermore, the sick-house syndrome widely occurs in an indoor environment. It is caused by various types of chemical substances released by building materials. Plants not only have only healing effects but also purification capabilities for indoor air pollutants and offensive odors.

Tanaka Y, Shimahara M, Hashiguchi N, Nagisa N, Koko K, Usuda K, Arisue M, Fukutomi A:
Quantity of bone in osteoporosis model

With the recent aging of society, aged patients with osteoporosis have been increasing in the field of orthopedic surgery. Though slight external force is considered to cause bone fracture in these patients, there have been no report of an increased incidence of fracture of the jaw in oral surgery.

All in all, the past scientific presentations and articles can be assembled into the following seven main categories: 1) General issues in combinations and complex environmental exposures, 2) Interactions between gases and particulates, 3) Combined exposure to physical factors, 4) Effects of combined exposures in the psychosocial work environment, 5) Effects from combined exposure to solvents, 6) Mechanisms of effects of combinations, and 7) Simulation and modeling.

In the course of years various terms and definitions have been used for describing effects and actions of similar or dissimilar environmental factors under study. The definitions and terms seem to depend on the disciplines, scientific schools or scientific heritages, countries or continents. Commonly used terms are listed in Table 1. Obviously it is needless to say that further work on international standardization, conceptual frameworks and agreements are required. Without reaching a mutual understanding comparisons of the results from different investigations are difficult.

Table 1. Commonly used terms for the analysis of combination effects

<table>
<thead>
<tr>
<th>Term</th>
<th>Combined effect said to be</th>
</tr>
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<tbody>
<tr>
<td>Augmentation</td>
<td>greater than expected</td>
</tr>
<tr>
<td>Enhancement</td>
<td></td>
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<tr>
<td>Potentiation</td>
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<tr>
<td>Sensitisation</td>
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</tbody>
</table>

ACES 15 (1-2) 2008
Our short lesson

Partly due to the global economy hectic and profound turmoils are taking place in the working life. Because of this, there is a growing tendency towards considering the globality of the modern work and work environment such as it is. It goes without saying that demands for correct and upgraded knowledge in this field are increasing greatly at work sites as the very result from new skill requirements and health issues

- related to new types of work
- related to new ways of organizing work
- related to new types of technologies
- related to new types of chemicals

Considering all these work related phenomena it is very urgent to conduct such holistic multidisciplinary studies and gather such knowledge that is both relevant and helpful to fulfill these requirements and in this way ensure the well-being of society, work communities and individuals. To refer to this functional wholeness and holistic approach the author has introduced the term Work Life Ability (www.worklifeability.net; see also The Handbook of Work Life Ability (Ed) O Manninen, Tampere, Finland 2008, ISBN 978-952-5264-75-3).
underlines the need to conduct our scientific work with extreme skill.

**Conclusion**

In future studies hypotheses should not only be formulated to examine whether relations exist between certain exposures and adverse health effects, but also to determined the relative importance of physical as well as social, organizational, and individual risk factors for the development and aggravation of various complaints. Consequently, many different aspects of the working situation and the worker’s capacity should be related to health effects rather than solely to a single exposure variable. Hereewith there is a list of various both practical and scientific means through which it is possible to increase reliability of studies on the actions and effects of combinations of various environmental factors.

- The researcher is familiar with his/her subject
- The researcher uses the correct indicators (indices of workloads)
- The researcher is familiar with the specific scientific language and common definitions approved (obvious semantic differences between cultures)
- The research and experimental settings are well designed and are suitable for the material at hand (block design experiment or variance analysis design experiment)
- The sample and study population are large enough (in laboratory experiments 5 and in field studies 10 observation units minimum)
- Sampling and collection of data has been timed right with a view to the studied phenomenon and its function (annual, diurnal variation)
- The subject and the criterion variables are correct (level of targets - molecule, cell, organ, organism)
- The follow-up time and duration of exposure are right (reliable reflection of actual working conditions)
- It is worth while to bear in mind the extrapolation problems related to studies on animals or human beings
- The effects of cutting points of discontinuity in continuous variables are known and eliminated from the results (risks of manipulation are known)
- Distinction between a dependent and an independent factor. Correlative explanatory variables should be rejected if multifactorial analytic statistical models are used
- Temptation and easiness to use ready-made library programs. Effects of skewed distribution are known and should be checked and eliminated from the results
- Even though studies on combinations help us to understand real world and real work life better it is worth while to bear in mind our limitation to understand multidimensional phenomena. Therefore the researcher must be absolutely sure what he/she wants to measure.

**Acknowledgements**

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PUBLICATIONS

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