IN-DEPTH REVIEW

Ageing and fitness to work

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Ageing workers can be found in almost all occupations. Assessment of fitness to work in these workers is important, as it aims to match their functional capacity (which is reduced compared to younger workers), to the demands of their work (which may remain the same as that for younger workers). This outcome of assessment is influenced by the interaction between functional capacity, state of health, the nature of work, and possibilities for work accommodation. The assessment of functional capacity should include physical, mental and social capacity, as well as assessment of any disability. In addition to clinical or laboratory measurements, several authors have suggested the use of a 'work ability index' for specific occupations as a practical means of selecting the appropriate worker for the job. This index can also be used for monitoring functional capacity. In addition, as for any fitness to work assessment, a good understanding of the nature of the work and the work environment is required, and possibilities for work accommodations considered. While changes in the work environment and working conditions can be made to suit the functional capacity of the ageing worker, the maintenance of functional capacity is another important issue. There is a place for a greater role for disease screening and health promotion for such workers.

Key words: Ageing worker; fitness to work; functional capacity; work ability.

INTRODUCTION

There is a general trend toward ‘ageing’ in the population of both industrialized and developing countries, as a result of longer life-spans and decreased fertility rates. A corresponding increase in the proportion of ageing people in various occupations is also observed. While an estimated 32% of workers were in the age group between 45 and 60 years of age, the respective percentage will be 35.5% in the year 2000, and 41.3% in the year 2010. Such a trend is particularly marked in Asia; in Japan for instance, three-quarters of the male population between 60 and 64 years of age are still in the labour force.

Ageing workers can be found in almost all types of occupation. Work demands and working environments are not necessarily different for ageing and young workers, and more often than not, are quite similar. Assessing fitness to work in the ageing worker is thus associated with a number of health, social and ethical considerations.

MORE THAN JUST A MEDICAL EXAMINATION: THE CONCEPT OF ‘PRODUCTIVE AGEING’ AT WORK

Ageing workers constitute a special group in the labour force, with characteristics that require special attention from the occupational health point of view. One of the main problems in ageing and work is the incompatibility between the functional capacity of the worker and the demands of the job. The work demands do not usually increase with time but work capacity usually decreases with age.

A ‘fitness to work’ assessment for the ageing worker is more than just a medical assessment: it requires that the physician understands the nature (work hazards and stressors) of the job, and has the ability to make recommendations for job redesign (the concept of ‘age-adjusted workload’). It also involves an understanding of the physiological changes in ageing and functional capacity of the individual, and would be an opportunity to promote health factors and prevent ill-health (the concept of ‘maintaining functional capacity’).

The concept of ‘productive ageing’, as described by Ilmarinen et al., is based on the principle that work demands should change, just as workers themselves change as they grow older. It should be emphasized that a number of mental and social abilities can undergo a positive change with increasing age, and such new
Job restrictions

The ageing worker may need to be reassigned away from some jobs, such as those with exposure to severe thermal stress, heavy and continuous effort, and enforced high work rates, and toward those that are more appropriate for reasons of work productivity and safety.3

Adaptability

Adaptability could be described as the ability to learn quickly, to grasp new ideas, to adapt to change and have the interest to be trained.25 Although older workers may have limitations that may affect their adaptability in some ways, they can generally learn; the difficulty sometimes arises when they are taught using techniques meant for younger workers.6,26,27

Role of a functional assessment

Assessing functional capacity, whether physical, mental or social, requires one to ‘peg’ at the level of functional competence required for the specific job. A particular system may be more relevant than others, and it may thus be easier for the physician to break down the work scope into the relevant systems involved.30,31 For example, a physically demanding job requires an assessment of one’s physical capacity, which could involve one or more of the following: physical body composition, musculoskeletal capacity, cardio-respiratory capacity, sensory organs, central nervous system and coordination. Mental capacity could require assessments of memory function, intelligence and ability to respond to safety. Jobs that need both physical and mental abilities may require assessing a mixture of the above systems.

Assessing physical capacity

Eyesight: visual capacity3,32,33

Accommodation acuity is decreased and presbyopia necessitates the use of reading glasses. There is diminished tolerance to glare sensitivity with slowing of adaptation to darkness, and colour discrimination is impaired. Close work and that involving accuracy, such as the assembling of electronic components, and repetitive quality checking, may be adversely affected. Adequate illumination while minimizing glare at work is thus important. There may also be concomitant diseases such as cataracts and age-related maculopathy, which can affect vision. Vision is important in workplace safety and thus should be part of the functional assessment.15
Ears, and hearing capacity\textsuperscript{3,32,33}

The phenomenon of presbyacusis, in which speech is distorted due to poor quality amplification, may be found in the elderly. The problem may be aggravated by working in a noisy environment, especially in jobs that demand concentration. Communication difficulties have safety implications and may lead inadvertently to social isolation for the elderly worker. Sometimes, degenerative changes in the inner ear can also affect balance control.\textsuperscript{15}

Musculoskeletal system: strength and coordination capacity\textsuperscript{3,32–34}

Loss of skeletal muscle results in decreased lean body mass. There is thus an increase in the ratio of fat to lean body mass. Muscular strength declines with age, with the rate of decline accelerating at the age of 50 years.\textsuperscript{35} Handling heavy materials is less well tolerated by older workers due to lower muscle strength and degenerative joint disease, and may lead to injury and accidents.\textsuperscript{36} Prolonged periods in an awkward position may also be less tolerable and may accelerate damage in joint tissue. There may also be diminished bone density and neuromuscular coordination. Speed and reaction is thus reduced; furthermore, repetitive jobs are more likely to lead to musculoskeletal disorders.

Examination for joint deformities, muscular atrophy and asymmetry is useful as they will have an effect on mobility, such as in a case of osteoarthritis of the knee. The site of the affected joint, whether it is in the upper or lower limb, or is of single or multiple involvement, will have an impact on the level of disability.\textsuperscript{15,37–39}

Cardiorespiratory system: aerobic capacity

The cardiorespiratory system undergoes a number of changes with ageing including a reduced cardiac output, decreased maximum breathing capacity and maximum oxygen uptake during physical exertion (reduced by about 60\% between 30 and 70 years of age).\textsuperscript{40,41} These changes can contribute to decreased effort tolerance. According to the ‘stress–strain concept’, in heavy physical work, maximal cardiorespiratory capacity determines the level of strain. The better the maximal oxygen consumption ($V_{\text{O2max}}$), the lower is the cardio-respiratory strain at a given work load.\textsuperscript{38}

Posture control: balance capacity

The elderly are unable to regain their balance quickly when tripped.\textsuperscript{14,32} Hence they are prone to frequent falls. Education of the worker, fellow workers and employer in hazard awareness at the workplace is essential for the ageing workers’ safety. Posture control can be tested by observing the amount of postural sway when standing upright with the eyes closed.

ASSESSING MENTAL CAPACITY\textsuperscript{3,32,44}

Age-related physiological changes that occur in perception, information processing, and motor performance may weaken most parts of an individual’s mental capacity.\textsuperscript{13} Psychomotor performance is slower and intellectual performance is decreased. Recent memory is impaired. Reaction time is also slower. These workers may also be slower in complex learning.\textsuperscript{45} Training an older worker in new skills may be challenging and the methods used may have to differ from that of a younger worker in that it should be more ‘practically’ based.\textsuperscript{46}

Assessing mental capacity is not a tedious process. The underlying principle is that the mental status of a worker will not compromise the safety of self or others at work. It should also be commensurate with the ability to perform the required tasks. In general, the physician should assess the following.

- The ability to understand and perform work,
- the ability to follow instructions,
- the ability to communicate and interact.

Mental state examination scales are available and are useful screening tools for the assessment of the worker’s psychological state, although there have not been studies which compare the reliability between scales for the working aged. The physician should try to be familiar with at least one type. The one that would be most useful when used for an elderly or geriatric individual is that which screens for cognitive function and depression.\textsuperscript{47,48} Examples include the Abbreviated Mental Test, and the Mini-mental State Tests.\textsuperscript{14,33}

ASSESSING SOCIAL CAPACITY

A social assessment is an integral part of the overall functional assessment of the older adult. It provides the social and emotional context of the individual, thereby interacting with physical and mental health, as well as work ability. It should include the physical environment (e.g. physical living and working conditions, safety), as well as the financial situation, social and community support system, psychological and emotional health and family dynamics.\textsuperscript{14,31}

A basic framework for functional capacity assessment is shown in Box 1. This could be combined with Box 2 to form a more complete checklist for the examining physician.

It can be seen that physical potentials, such as aerobic capacity, strength and coordination capacity, can be maintained or improved to a certain extent with the aid of exercises, healthy lifestyle, prevention of disease and vocational training.\textsuperscript{9,23,33,50–53} The other potentials, such as eyesight and hearing, could be enhanced with simple measures at work such as better illumination and minimizing unnecessary ambient noise. In comparison, mental potential is less amenable to enhancement.
HEALTH AND WORK DISABILITY

The health status of the ageing worker is lower than that of younger workers. There is a definite increase in the prevalence and incidence rate of diseases, including that of occupational and work-related diseases. It is estimated that between one-third and two-thirds of workers aged 50 years and older have at least one diagnosed disease, mainly musculoskeletal or cardiovascular. Most prevalent are arthritis (53%), hypertension (42%), hearing impairment (40%) and heart disease (40%). This may translate to an inherently higher health care cost. The elderly also have a higher incidence of certain psychiatric conditions, such as depression and dementia.

Work disability refers to the inability to work due to illness or disability. All the above factors contribute to the higher work disability rates seen in ageing workers. Others include psycho-social factors and healthy living habits of the individual.

Where workers were grouped into physical, mental or mixed physical and mental job categories (to be discussed in the next section), the highest disease prevalence is found in physically demanding occupations and for men in work with mixed demands. Female auxiliary workers, domestic helpers and cooks, as well as male installation and transport workers, exhibited the poorest health. Men and women in intellectual work exhibited the best health and work ability.

In associated studies of mortality, disability and changes in occupation among ageing workers in a developed country, the rates were highest in occupations involving heavy physical work, poor work posture and a poor physical environment. This was especially so in installation and auxiliary male workers. The main diseases which led to disability included malignancy, coronary artery disease, congestive heart failure, rheumatoid arthritis, bronchitis and mental illness.

Work stress can be a real problem in the ageing worker. Some studies have shown that stress levels are higher in the older working populations. This has significant implications on the health and well-being of the worker as it has been observed that work-stress related reactions were associated with both mortality and disability. In the model of ageing proposed by Goedhard, it was suggested that stress is an external source that might influence the rate of ageing.

In assessing fitness to work for the ageing worker, it is likely that the worker may have some form of chronic illness. One may want to assess work disability for that particular illness and also correlate with his functional status or work ability.

UNDERSTANDING THE NATURE OF WORK AND ITS ENVIRONMENT

A medical assessment alone is not sufficient to assess employability of a worker. The physician needs to understand the environmental risks involved and the nature of the job. This becomes even more relevant when workplace adjustments may be recommended to suit the ability of the ageing worker in meeting the needs of the employer.

Nature of work

Although there have been a number of methods proposed to classify occupations, these have largely been used in research to study the relationship between work and health. For practical purposes, for ageing working populations, the nature of work could be conveniently classified into physical, mental or mixed (a combination of physical and mental). Physical work is dominated by muscular work and high physical work load as exemplified by auxiliary work, installation and home care. Mental work primarily demands mental effort, as seen in administrative and management jobs, technical supervision and teaching. The mixed work group is characterized by both physical and mental effort, such as nursing, transport, kitchen supervision and dental work.

Such a classification would assist in matching the ageing worker's functional capacity with his job requirements. For instance, a high degree of physical capacity would be required for a 'physical' job scope rather than mental capacity. Conversely, one with physical disability need not necessarily be excluded from an administrative job.

The U.S. Department of Labor in its Dictionary of Occupational Titles has refined this concept effectively. Jobs are graded according to physical demands, environmental conditions, certain levels of skill and knowledge, and specific vocational training required. Parameters assessed for physical demands include strength (expressed by sedentary, light, medium, heavy and very heavy), climbing/balancing, stooping/kneeling/crouching/crawling, reaching/ handling/fingering/feeling, talking, hearing and seeing (expressed by acuity, depth perception, field of vision, accommodation and colour vision).

Work environment

The work environment plays a prominent role in evoking negative health outcomes in workers. Ageing workers are at higher risk of work-related and occupational diseases. This may be due to having a longer cumulative exposure to work hazards such as chemicals or noise. Furthermore, there is likely to be an associated impairment of organ function. This is complicated by a higher unpredictability of the ageing worker's response to exposure to various work hazards. The implication is that certain environmental conditions should warrant a pre-employment and periodic fitness to work examination for the ageing worker to protect his health.

The WHO Study Group on 'Ageing and Work Capacity' has described several aspects of working conditions which should derive special attention in the case of ageing workers. These factors are summarized in Table I, and include:
BOX 1. A suggested work checklist to be used when determining an ageing worker’s medical fitness*

MEDICAL HISTORY

Personal biodata
- Age
- Gender
- Distance from home

Occupational history

Medical assessment
- Medical history
- Drug history

Social history
- Physical environment
- Financial status
- Family/social support

Lifestyle health factors
- Smoking
- Alcohol
- Physical exercise

PHYSICAL EXAMINATION/INVESTIGATIONS

Vision
- Visual acuity with Snellen’s chart (both uncorrected and corrected)

Hearing
- Ease of communication with patient
- Otoscopic examination for ear wax impaction in elderly

Aerobic capacity
- Cardiorespiratory medical examination
- Respiratory function tests
- Submaximal exercise tests

Upper and lower limb function and musculoskeletal capacity
- Any deformities

*For completeness this checklist should be combined with the information outlined in Box 2.

Any tremor or rigidity
Exclude any orthopaedic conditions
Functional assessment e.g. grip strength, coordination, ability to pull/push
Range of movement
Gait
Mobility

Balance
- Postural sway with eyes closed and manually pushing
- Any postural hypotension
- Vertigo/tinnitus present

Mental state
- General assessment
- Ability to understand and perform work
- Ability to follow instructions
- Ability to communicate and interact
- Ability to manage own safety at work
- General health questionnaire
- Mini-mental examination for cognition and depression in elderly
- Psychiatric referral when required

SPECIAL REQUIREMENTS (to list)

May include the provision of special diets (e.g. low calorie, low salt); a designated clean area, which does not have to be large, for self-treatment, such as injections; arrangements to cope with an inability to tolerate shiftwork— if possible, fixed hours should be defined; frequent rest periods—the supervisor should be informed; uncluttered work stations that are modified reasonably to suit the worker, e.g. with better illumination; easy accessibility to the workplace—appropriate transport arrangements should be made.

FITNESS TO WORK

Yes, with the following requirements (list)
No, for the following reasons (list)

- work organization—pace of work, working hours, variety;
- psychological factors—work roles, participation, control;
- ergonomic factors—repetitive jobs, posture, handling of heavy materials, speed, precision, anthropometric changes;
- physical factors—noise, vibration, heat, pressure, lighting;
- chemical factors—cumulative hazardous chemical exposure.

These factors often translate to ‘stress’ factors. In a study of 13 occupational groups in Finland, the data have suggested that the older worker in the work environment is often exposed to more than 10 stress factors at levels that exceed 50% of the maximal theoretical duration, frequency or significance.
Table 1. Working conditions that are important for the ageing worker*

<table>
<thead>
<tr>
<th>Factor</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work organization</td>
<td></td>
</tr>
<tr>
<td>Pace of work</td>
<td>Pace should be comfortable for worker rather than set by machines/organization</td>
</tr>
<tr>
<td>Working hours</td>
<td>Shorter working hours especially if work is physically or cognitively demanding</td>
</tr>
<tr>
<td>Variety</td>
<td>Workers of limited physical and cognitive abilities benefit from variety</td>
</tr>
<tr>
<td>Psychological factors</td>
<td></td>
</tr>
<tr>
<td>Work roles</td>
<td>Roles to be defined</td>
</tr>
<tr>
<td>Job security</td>
<td>Will affect performance and health</td>
</tr>
<tr>
<td>Ergonomic factors</td>
<td></td>
</tr>
<tr>
<td>Repetitive jobs</td>
<td>Susceptible to musculoskeletal disorders</td>
</tr>
<tr>
<td>Posture</td>
<td>Lower tolerance to awkward postures</td>
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<tr>
<td>Handling of heavy materials</td>
<td>Lower muscle strength and degenerative joint disease</td>
</tr>
<tr>
<td>Speed</td>
<td>Body movements not as quick for certain tasks</td>
</tr>
<tr>
<td>Precision</td>
<td>Requires static loading and good lighting</td>
</tr>
<tr>
<td>High aerobic demands</td>
<td>Risk of fatigue and accidents</td>
</tr>
<tr>
<td>Anthropometric changes</td>
<td>Changes in physique</td>
</tr>
<tr>
<td>Physical factors</td>
<td></td>
</tr>
<tr>
<td>Noise</td>
<td>Hearing difficulties and easily disturbed in concentration-demanding jobs</td>
</tr>
<tr>
<td>Vibration</td>
<td>Lower tissue and muscle stress tolerance</td>
</tr>
<tr>
<td>Heat</td>
<td>Lower tolerance to extreme temperatures</td>
</tr>
<tr>
<td>Pressure</td>
<td>Less tolerance to hyperbaric conditions</td>
</tr>
<tr>
<td>Lighting</td>
<td>Lower adaptation to poor lighting</td>
</tr>
<tr>
<td>Chemical factors</td>
<td></td>
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</tbody>
</table>

*Information given in this table is based upon that in the WHO technical report Ageing and Working Capacity.*

**DETERMINANTS OF WORK ABILITY**

Work ability is an interaction of social, environmental and individual factors, including physical fitness, coping skills, social support behaviour and health behaviour.\(^8\)\(^9\) In other words, work ability does not depend on functional capacity alone. It is complicated by the influence of external factors such as task demands, subjective effects of workload, objective effects of workload, and latitude of control.\(^6\)\(^7\) Furthermore, functional decrease could result in reduced job productivity and a higher risk of occupational and work-related diseases, thereby initiating a vicious cycle of deteriorating functional capacity and work ability. Matching workers with job demands, whether physical, mental or mixed, may therefore ensure some degree of work-relatedness and promote individual work performance.

Despite the number of studies undertaken, there is very little information of how much these factors contribute to an individual’s work ability. Ageing was consistently found to reduce work ability. For instance, it was shown that a significant decline occurs after a mean age of 51 years and the annual decline of work ability was highest for women at 51 years.\(^10\)\(^6\)\(^2\) In the same study, it was found that at least 25% of installation, auxiliary or transport workers had a poor work ability rating, as did women doing kitchen supervision and home care work at a mean age of 58 years. Other important factors included mental symptoms and musculoskeletal disease. Poor work ability was also particularly associated with occupations that involved mixed physical and mental work, followed by physical work (blue collar workers). Men and women whose jobs involved mostly mental work reported the best work ability.\(^6\)\(^2\)

Associations were also found between high physical demands at work, poor physical work environment, lack of freedom, decreased recognition and esteem, increase in standing at work, and a decrease in vigorous leisure-time physical exercise.\(^23\)\(^6\)\(^8\)

Conversely, factors at work which seemed to promote work ability included improvement of the supervisor’s attitude, decreased repetitive movements, and physical exercise during leisure time.\(^23\) In workers who had existing cardiovascular disease, a low level of muscular work and a high level of leisure-time physical exercise appeared to decrease work disability. When compared with work ability of active workers, work disability was linked to individual rather than workload factors.\(^10\)

It has also been found that ability of the ageing workers has improved significantly over the years. In a Californian study which tried to justify a later retirement age, it was observed that men and women in their 60s, i.e. those in the older working ages and younger retirement ages, reported a significant improvement in their ability to work.\(^48\) The change in work ability was significant enough to show that the percentage unable to work at the age of 67 years in 1993 was lower than the percentage unable to work at the age of 65 years in 1982. The improvement in health was attributed to the higher educational status, better health and a decline in the prevalence of cardiovascular disease and arthritis. It has

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**BOX 2. Assessing job demands**

**REQUIREMENTS OF THE JOB**

Work demands

Work environment and safety

Ergonomic aspects

Travel requirements (if any)

Physical/intellectual/perceptual

List risk factors:

Specify if any:

It is difficult to identify specific occupations from which the ageing worker should be excluded. Chronological age by itself should not be an absolute contraindication, and it should be based upon the occupational health and safety legislation for the particular occupation.
also been shown that both older and younger workers were able to improve their work ability.23

It is a challenge to try to integrate the different facets of individual characteristics and functional capacity into a specific work ability index for different occupations. Unfortunately, attempts to determine an objective method of combining physiological, biochemical and psychological data, which yields an index of the biological age of the individual (a biological marker of ageing) has so far not been successful.69,70

On the other hand, subjective indices on work ability devised by various investigators have shown that it is possible to measure work ability by means of a summarized index, but unfortunately, these have so far not been validated. These indices have been based on a variety of factors including self-assessments of health and work capacity, clinical evaluation, life-style factors, objective tests to measure aerobic capacity, work environment and demands, and work performance.9,10,23,62,66,68,71–75 A programme for ageing workers at the workplace could include regular monitoring of work ability.7

Some of the findings have shown good correlation with the clinical assessment of health status and work ability at the group level.76 It was found that of the physical capacity tests, muscular strength correlated best with work ability when compared with cardio-respiratory capacity. Mental capacity tests, including visuo-motor speed, also had consistently lower correlation than physical capacity tests.24 Others have also indicated that such tests have predictive value in assessing a later disability to work.

The work ability index has other applications. It has been used as a marker to predict an improvement or decline in work ability in later life.9,75 It has also been developed for use to identify early signs of decreasing work ability, such that preventive measures could be planned. There has been limited success for a few occupations including fire fighters, construction workers and teachers.77–79

PERIODIC ASSESSMENTS AND OTHER ASPECTS OF FITNESS TO WORK IN AGEING

In periodic assessments, fitness for work does not usually end with a medical and work ability assessment. There is an important role for maintaining functional capacity especially in the case of the ageing worker. Measures will include health promotion such as policies on smoking, diet, alcohol consumption and physical exercise.80

With a higher incidence of disease, appropriate screening for chronic diseases becomes more relevant in the ageing worker. Disease screening should follow the guidelines of the respective major organizations and agencies such as the American College of Medicine, U.S. Preventive Service Task Force, American Academy of Family Physicians or other professional organizations.81 The main difficulties, sometimes, are the lack of effective tests or screening tools. Diseases which can be usefully screened include hypertension, diabetes mellitus, hyperlipidaemia, and malignancies such as cervical cancer and breast cancer. It should be noted that the U.S. Preventive Service Task Force and the American College of Physicians find insufficient evidence for or against screening for those above 65 years of age, but do recommend screening those healthy individuals between 65 and 75 years who have coronary heart disease risk factors. Screening is not advised after 75 years of age.

There may also be a wish to screen for psychological conditions of the ageing worker by assessing the social well-being and stress levels of the individual.82–85 This could be done simply with the aid of a short general health questionnaire and enquiring about the social history.

It is also important to screen for disease factors which may have an impact on workplace safety. Ophthalmic disorders such as cataracts and age-related macular changes, aural problems such as conduction and sensori-neural hearing loss, and balance control such as inner ear disturbances, may be especially relevant in the elderly worker.

CONCLUSION

Work capacity or job performance in the ageing worker is multifactorial, involving an interaction between functional capacity, health and the nature of the work. Assessing fitness to work is thus a two-pronged process of identifying work ability (whether physical, mental or mixed) of the individual (while screening for pathological disease) and correlating it with the respective nature of the work, with reasonable job re-design. Besides clinical or laboratory measurements, it is possible to construct a 'work ability index' for a specific occupation as a practical means of selecting the appropriate worker for the job and monitoring his functional capacity. There is also a greater role for health promotion, disease screening for maintenance of functional capacity, and possibilities for work accommodation.

REFERENCES


