Evidence base for pre-employment medical screening

Joseph Pachman [a]

Abstract This paper examines the evidence base for the use of pre-employment/pre-placement medical examinations. The use of pre-employment examinations is often driven more by cultural practices than evidence. There is a lack of evidence on their effectiveness in preventing health-related occupational risks. Hypertension screening is highlighted as a common pre-employment practice for which there is no standardized criteria to use to determine fitness for work. There are inherent problems in screening for psychiatric disorders and substance abuse as well as potential for racial bias and other unintended negative effects. This paper questions the economic case for this practice and also expresses concerns about paternalism related to identified risk factors. Health assessments should only be included when appropriate to the task environment and the general use of pre-employment exams and drug screening should be eliminated. Generally, a health assessment by questionnaire should suffice. Occupational health providers should advise against the application of physical or mental standards that are not relevant to fulfilment of the essential job functions. Consensus development regarding best practice, as well as consideration for acquiring outcome data related to pre-employment practice, is recommended.

Une traduction en français de ce résumé figure à la fin de l'article. *Al final del artículo se facilita una traducción al español.* الترجمة العربية لهذه الخلاصة في نهاية النص الكامل لهذه المقالة.

Introduction

Ideally, the pre-employment medical examination (also referred to as a pre-placement examination) strives to place and maintain employees in an occupational environment adapted to their physiological and psychological capacities. The goal of the pre-employment examination is to determine whether an individual is fit to perform his or her job without risk to himself or others.[1] This is also conceptualized within the practice of occupational medicine – it is assumed that the examiner is required to have detailed knowledge of both working and health conditions.[2]

Over the past 20 years, medicine has undergone a significant paradigm shift.[3] Traditionally, the application of medical principles was a static process, modified on occasion by the practitioner's experience. More recently, in part fuelled by computer-accessible databases, techniques of systematic review of data of clinical guidelines and economic analyses have become more established. For a variety of reasons, these evidence-based methods have only recently been applied to occupational health risks and interventions. As noted by Carter, the application of these methods in occupational medicine would likewise "improve the quality of prevention and would also enable practitioners to give more soundly based advice and to secure their professional positions as providers of quality assured information".[3]

Evidence-based medicine promotes the appraisal and application of best practices in health care.[4] There is a growing awareness that decisions in occupational health practice should be supported by evidence. However, in comparison with clinical research, occupational health research does provide some unique challenges. In addition to the general absence of randomly controlled studies, unique barriers to implementation need to be considered.[4]

Unfortunately, the use of pre-employment examinations can be considered to have been more cultural than data driven. In this context, it is interesting to consider how, for example, an equivalent ritual practice occurring in a less-developed country might be viewed. There is very little empirical evidence in support of pre-employment examinations, relative to either economic or health outcomes.[1] As Carter has pointed out, the ritualistic use of pre-employment examinations might occur because much occupational practice is driven by a "compliance mentality".[3] Perhaps, most importantly, users of occupational health practices frequently value stability more than improvement, especially as it is generally not seen as core to the business. Occupational physicians are part of this process that values tradition more than evidence. Often, these physicians have championed current practices within the organization for a variety of reasons. They often believe that they are too busy or pragmatic to examine processes that might undermine their own job security. More often, they are simply enmeshed in a cultural tradition that also has intuitive appeal, driven by "the need to do something".[5]

The objective of pre-employment examinations has traditionally been to ensure that prospective employees can perform their jobs safely without placing co-workers at risk. Despite these focused goals, pre-employment testing often exceeds this scope.[6] Indiscriminate testing inevitably yields findings that are not relevant.[7] The required follow-up or "clearance" for these findings can delay employment, result in the spurious rejection of a candidate, divert resources from efforts that might be beneficial to health outcomes, as well as cause unnecessary expense.[7]

An example of a long-established occupational health practice that has recently undergone scrutiny is the pre-employment chest X-ray. Loyhiya et al. undertook an empirical analysis of the efficacy of this practice. They concluded that the use of the chest X-ray in this setting was contrary to established practice guidelines, unnecessary and wasteful.[8]

[a] Centre of Continuing Studies, University of Connecticut, Storrs, CT 06269, United States of America.
Correspondence to Joseph Pachman (e-mail: jpctny@yahoo.com).
(*Submitted: 3 March 2008 – Revised version received: 11 October 2008 – Accepted: 19 October 2008 – Published online: 26 May 2009*)

Hessel & Zeiss examined the value of the medical assessment examination that was used for both pre-employment and periodically during employment.[9] They found that as a screening examination, very little benefit was realized. Only 1.7% of examinations resulted in diagnoses considered to be significant according to defined criteria.

The most detailed assessment of the criteria and methods used in the pre-employment examination as an assessment of fitness for work was performed by Serra et al. in 2006.[2] The authors analysed all published research regarding fitness-for-work examinations from 1966–2005. They hypothesized that, despite the acceptance of this process, there were few to no validated criteria or research that would support their efficacy.

The consensus was that fitness for work is mainly determined by physical demands and not by medical conditions (with psychiatric conditions a possible exception).[10] In addition, the assessment of fitness for work is a better predictor of future health outcomes and costs than medical diagnoses.[11] Most importantly, despite being common practice in occupational medicine, the validity and effectiveness of judgements on unfitness for work are not based on evidence and are likely "doubtful".[12] Shepherd concluded that there is scant evidence on the effectiveness of pre-employment examinations to prevent future health-related occupational risks.[13]

Screening for hypertension

Even for common medical conditions such as hypertension, no standardized criteria are used to determine fitness for work.[14] For example, in the United States of America (USA), the Federal Aviation Administration (FAA) requirement for fitness for flying is 155 mmHg (20.6 kPa) while the Department of Transportation requirement for operating a commercial motor vehicle is 140 mmHg (18.6 kPa). Are we to assume that there is a higher medical threshold for operating a motor vehicle than for flying an aeroplane? It is likely that the political context needs to be considered. The airline union lobbied against excluding pilots on the basis of age. As hypertension is correlated with age, was a political decision presented as "medical" criteria?

Cut-off values of blood pressure in the pre-employment examination have been found to be arbitrary, variable and unrelated to the type of work tasks.[14] There is concern regarding inappropriate job exclusion on this basis.[2] In addition, there is no consensus in the literature as to whether hypertensive complications are occupation dependent. For example, a large prospective study of 270 000 employees of Bell, an American telecommunications company, revealed no excess in coronary heart disease in workers in higher management, those with the greatest responsibilities or those experiencing the most frequent job changes.[15]

Potential racial bias

Continuing with the example of blood pressure, it has been established that African Americans are at a higher risk for higher blood pressure and hypertension. Is it implicitly, if not explicitly, discriminatory to use this (arbitrary) criteria as a basis for job exclusion? Murphy conducted a survey to determine whether occupational physicians exclude job applicants by applying blood pressure criteria.[14] Sixty eight percent of the physicians reported excluding job applicants with hypertension permanently, on their own initiative. The author also noted that "the high prevalence of hypertension in the adult population ensures that its widespread use as a criterion for employment would have significant social implications".

Another example of potential racial bias can be seen in the use of pre-employment screening for glucose-6-phosphate dehydrogenase (G6PD) in the chemical industry. Theoretically, the absence of this enzyme could place an individual at an increased risk for haemolysis if exposed to certain oxidizing chemicals. In reality, there is no increased risk in the workplace.[16] However, the chemical industry continues to commonly use this component of the pre-employment examination and to exclude candidates on this basis. The incidence of G6PD deficiency is higher among dark-skinned individuals by a significantly higher margin (i.e. 10% of a dark-skinned population versus < 1% of a fair-skinned population). Certainly, a G6PD deficiency does not meet the threshold of a direct threat, as interpreted by the Equal Employment Opportunity Commission (i.e. a risk that is significant, key, imminent and severe; supported by scientific evidence, not prejudice or supposition; and based on an individual assessment, not generalizations about a group of persons). In the South African mining industry, dark-skinned miners are screened more frequently than lighter-skinned workers.[9] Clearly, the assessment of fitness for a job needs to be considered in the context of human rights.

Although physicians frequently are required to evaluate medical risk in the workplace, there is generally no accepted strategy or evidence-based strategy for these analyses.[17] In general, there is very little data regarding the susceptibility of workers with any chronic diseases to workplace exposures and their ability to sustain employment. Workers with chronic medical conditions vary in their probability of becoming ill depending on their underlying health, their ability to adhere to treatment, as well as intrinsic variability.[18]

Economic considerations

Another concern regards the use of arbitrary medical criteria as surrogates for economic decisions. A survey in the USA found that 68% of occupational physicians reported certifying candidates with hypertension as unfit because their inclusion in the workplace would increase the company's health insurance premium.[14] Ironically, the existing research suggests that pre-employment examinations are not even cost-effective in reducing a company's potential financial liability.[13] There also appears to be no added value for the pre-employment process regarding indirect costs. Collings found no difference in future rates of absenteeism as a result of pre-employment examination findings.[19] Lowenthal, using retrospective chart reviews, found no significant effect on employee longevity, workers' compensation claims experience or utilization of health-care resources.[20]

Unintended negative effects

There are two different requirements for medical standards in the aviation industry. An employer invests not only in short-term safety but in the employee remaining fit throughout his or her career. On the other hand, the

national authority responsible for air safety (e.g. the Civil Aviation Authority in the United Kingdom of Great Britain and Northern Ireland, the FAA in the USA) is only concerned with ensuring that the licence holder will be unlikely to suffer sudden incapacitation during a short period (e.g. six months to one year) for which his or her medical certificate is valid.[21] There is some international agreement on the medical standards for pilots, flight engineers and air traffic control officers.[21] More recently, the Joint Aviation Authorities have produced a set of European standards. In all cases, the International Civil Aviation Organization, a United Nations agency, issues guidance material on the interpretation of standards. Experience suggests that accident risk increases directly with the total number of medical disabilities.[21] This risk also falls dramatically with increasing age, at least up until the age of 60. Unnecessary removal of middle-aged pilots on medical grounds by younger, less experienced pilots has been shown to be detrimental to air safety.[21]

During the FAA pre-employment medical examination, medication use requires consideration. If a prospective pilot indicates that they use prescribed medication to treat depression, they are automatically disqualified without recourse of appeal. Since women are more likely to be diagnosed and treated with antidepressant medication, consideration needs to also be given to gender bias in pre-employment examinations. As is often the case, this criterion is arbitrary and not supported by scientific evidence. The reality is that the exclusion criteria may encourage pilots to fly when they are depressed and, more alarmingly, self-medicate some of the symptoms of depression (e.g. early morning awakening) with over-the-counter medications, such as diphenhydramine. The dictum "first do no harm" appears to be ignored in what is often considered an otherwise benign, if not effective, process. Regarding the industry in general, McGregor has referenced the high degree of subjectivity regarding pre-employment exams in the entire airline industry.[22]

In the same context, the issues of shame and humiliation should also be considered. For example, as part of the USA's Reserve Officer Training Corps "pre-employment" process, young men and women, typically of 17 years of age, are subjected to a physical exam that includes an anal inspection by the examiner. If the examining physician indicates that this portion of the examination was deferred, the candidates are not eligible to proceed to training. Although this might be considered an extreme example, it is likely that undue anxiety is experienced by pre-employment candidates yet this requirement is arbitrary and unsubstantiated. At the pre-employment level, regarding fitness for military duty, Popper has criticized the medical process as being mechanistic and fragmented.[23]

Paternalism versus risk factors

Physical capacity is essential for highly demanding occupations, especially when public safety is involved.[2] However, often non-essential job elements are included. For example, it is a common practice to measure nicotine levels during pre-employment examinations for prospective firefighters. While the effects of smoking are well known, this behaviour does not represent a "direct threat" (i.e. the evolving legal standard which includes the components of imminent threat).[24]

Smoking has been found to be related to an increased risk of work-related injury.[25] However, as pointed out by the authors, using smoking as a medical exclusion criteria would result in unemployment of an unacceptably high percentage of many populations. Furthermore, given that many risk factors (such as smoking) are associated with higher job demands as well as long latency of onset, many workers would not be able to change jobs.

The Americans for Disability Act includes the notion that overprotection or paternalism of workers is not acceptable. In the case of using nicotine levels to determine smoking behaviour, it is not clear if the objective is the latter or if it is more related to potential economic results, as discussed above. Moreover, there is no evidence of an added economic benefit to the business of pre-employment medical exams. However, the pre-employment examination could be transformed into a health promotion process that includes a discussion of risk factors. As Chau et al. have indicated, preventive measures could help make workers aware of risks and therefore improve their lifestyles.[25]

Psychiatric disorders and substance abuse

Mental health dysfunction is reported to be related to absenteeism, long-term sickness and early retirement.[26] According to Glozier et al., mental ill health is the second largest cause of work-related problems, after musculoskeletal dysfunction.[26] In the United Kingdom, mental illness accounts for one third of all work-related illness, is the second major cause of long-term occupational absence and is responsible for 20% of early retirement.[27,28]

Not surprisingly, surveys in both Canada and the USA have suggested that workers with alcohol and substance abuse have significantly higher rates of disability.[29,30] In addition, Kessler et al. have found that combinations of mental illness, substance abuse and chronic physical illness result in greater disability than would be predicted by simply adding their component effects.[29] A previous history of low back pain, particularly when associated with absence from work for more than one month or co-morbidity with depression, was associated with significantly higher absence from work.[30,31] In addition, certain conditions are more critical because of their potential for serious workplace disruption. For example, it is generally accepted that workplace violence should be prevented to "the greatest degree possible, by careful evaluation of fitness for work".[32] Unfortunately, assessment of mental health and the potential for alcohol abuse, including the use of standardized screening questionnaires such as MAST (Michigan Alcohol Screening Test) or psychiatric illness history, during the pre-employment examination has not fared well.[32] In contrast, work history has been found to be the most important element in assessing fitness for work.[33,34] The most important variable in predicting the risk of violence in the workplace is a past history of poorly controlled aggression.[32]

The presence of psychiatric conditions in the workplace is a problem of ever-increasing significance.[32] However, Glozier et al. concluded that screening for common mental disorders during a pre-employment process was "pointless".[26] Even in the case of depression and anxiety, there is no empirical evidence regarding variables that might predict successful employment.[35] However,

community surveys in both Canada and the USA have found that people with substance abuse problems do experience more disability days than the rest of the population.[29,30] In a study performed for the International Labour Organization, it was noted that approximately 80% of drug testing worldwide occurred as part of a pre-employment process.[36] Similarly, pre-employment drug testing was performed by 98% of companies in the USA, while only 3% of companies did this in 1986.[37,38] However, 80% of the companies acknowledged that they had never performed a cost-effectiveness analysis. One such analysis concluded that it cost a company US$ 77 000 to find one substance user during the pre-employment process.[38] It appears that pre-employment testing has no impact on reducing either absenteeism or productivity and so White has suggested that there is insufficient support for drug testing programmes as pre-employment tools.[38]

Shahandeh & Coborn pointed out the ethical issues that arose as a result of workplace drug testing in Europe.[36] White has also discussed privacy and civil rights issues.[38] French, Roebuck & Alexandre concluded that, "besides the legal ramifications, drug testing worksites may discourage highly productive employees".[37]

Conclusion

Any health assessment should be appropriate to the requirement.[39] Medical examinations are only justified when the job involves working in hazardous environments, requires high standards of fitness, is required by law or when the safety of other workers or of the public is concerned. Generally, a health assessment by questionnaire should suffice and physicians should advise against the application of physical or mental standards that are not relevant to fulfilment of the essential job functions.

Accordingly, to satisfy duty-of-care requirements without discriminating against people, it is important to undertake a case-specific assessment of risk. To accomplish this, knowledge of the relevant medical history, the proposed job and the work location is required.[40] Three specific recommendations are suggested. First, to eliminate the pre-employment physical examination. It is reasonable to require an applicant to complete a medical history form. A medical examiner can then review this with the applicant, including a discussion of risk factors and strategies for health promotion. It is likely that medical examiners will need some brief training in this process. It has been argued that evidence alone is often not a sufficient guide for action in occupational health.[41] According to Franco, "the occupational health physician must have skills to identify the problem in its context correctly".[41] Accordingly, it is recommended that a job-demands analysis should be available for inspection by the physician. Medical examiners should be able to request additional testing or data as is deemed necessary, especially in consideration of certain international assignments.

Second, to eliminate pre-employment drug screening. There is insufficient evidence to suggest that this process is cost-effective. This screening likely represents an expensive and redundant alternative to an examination of previous work history.

Third, to develop some consensus regarding best practice and conduct clinical trials regarding assumptions. If a set of consensus-based recommendations can be developed, assistance should be provided to medical directors and others to implement change. Appreciate that a paradigm change of any sort is difficult to occur and improvement goals should be incremental. Focus should be on the ethical and evidence-base for pre-employment practices. Ideally, these practices should not exclude impaired or at-risk workers but should strive to fit jobs to their abilities and provide counselling for risk management. ■

Acknowledgements

I would like to thank Dr Allen of the University of Connecticut School of Humanitarian Administrative Studies, Dr Glen Pransky, Liberty Mutual Research Institute for Safety, and Dr Brian Davies, Medical Director of the United Nations Medical Service, for their support.

Funding: There was no funding for this paper. This work was performed on a voluntary basis at the request of the United Nations Medical Services.

Competing interests: None declared.

Résumé

Base factuelle au faveur de dépistage par l'examen médical à l'embauche

Le présent article examine l'ensemble des éléments en faveur de l'examen médical à l'embauche. La pratique de cet examen est souvent davantage motivée par des habitudes culturelles que par des éléments factuels. On manque de preuves quant à son efficacité pour prévenir les risques professionnels liés à la santé. Le dépistage de l'hypertension est mis en avant en tant que pratique courante lors de l'examen d'embauche pour laquelle il n'existe pas de critère normalisé permettant de déterminer l'aptitude au travail. Le dépistage des troubles psychiatriques et de l'abus de substances comporte des difficultés inhérentes, ainsi que des biais raciaux et d'autres effets négatifs non recherchés. L'article conteste les arguments économiques en faveur de cette pratique et s'inquiète de la possibilité d'une attitude paternaliste à l'égard des facteurs de risque identifiés. Une évaluation de l'état de santé n'est à prévoir que si elle est justifiée par l'environnement de travail et l'usage généralisé de l'examen d'embauche et du dépistage des drogues est à proscrire. D'une manière générale, une évaluation de l'état de santé par questionnaire devrait suffire. Les médecins du travail devraient déconseiller l'utilisation de normes physiques ou mentales ne s'appliquant pas à l'exécution des fonctions essentielles du poste. Les auteurs recommandent de rechercher un consensus sur les meilleures pratiques à appliquer et de collecter des données sur les résultats de la pratique des examens à l'embauche.

Resumen

Base científica del cribado médico previo al empleo

Se analiza en este artículo la evidencia disponible para justificar la realización de pruebas médicas antes del empleo o contratación. A menudo el recurso a esos exámenes obedece más a factores culturales que a la existencia de datos científicos que los avalen. No hay evidencia suficiente respecto a su eficacia como medida de prevención de los riesgos ocupacionales relacionados con la salud. Se ha resaltado el cribado de la hipertensión como una práctica común previa al empleo respecto a la cual no hay ningún criterio normalizado que permita determinar la idoneidad para el trabajo considerado. El cribado de los trastornos psiquiátricos y el abuso de sustancias plantea problemas peculiares, a lo que hay que añadir el riesgo de sesgo racial y otros efectos negativos imprevistos. Se cuestionan las razones económicas aducidas para justificar esas prácticas, y se considera preocupante el paternalismo relacionado con los factores de riesgo identificados. Las pruebas médicas sólo deben efectuarse cuando estén justificadas por el entorno laboral, y la realización de exámenes médicos y análisis de cribado de drogas previos al empleo como norma habitual es una opción que debería descartarse. Por lo general, debería bastar una simple evaluación del estado de salud a través de un cuestionario. Se debería disuadir a los proveedores de servicios de salud ocupacional de aplicar estándares de salud física o mental no pertinentes para el desempeño del trabajo fundamental a realizar. Se recomienda llegar a consensos sobre las prácticas más adecuadas, y estudiar la posibilidad de reunir datos sobre los resultados conseguidos mediante las prácticas de realización de exámenes previos al empleo.

ملخص

قاعدة للبيِّنات حول التحريات الطبية السابقة للتوظيف

تدرس هذه الورقة قاعدة البيِّنات حول استخدام الفحوصات الطبية السابقة للتوظيف أو لاستلام الوظائف. فاستخدام الفحوصات السابقة للتوظيف يأخذ توجُّهه في غالب الأحيان من الممارسات المجتمعية أكثر مما يأخذه من البيِّنات، ولا توجد بيِّنات حول فعالية الفحوصات الطبية السابقة للتوظيف في الوقاية من الأخطار المهنية المتعلقة بالصحة. ويُعَدُّ تحرِّي ارتفاع ضغط الدم من الممارسات الشائعة قبل التوظيف دون أن يكون لاستخدامه معايير قياسية لتحديد مدى الصلاحية للعمل. وهناك مشكلات متأصلة في تحرِّي الاضطرابات النفسية وتعاطي مواد الإدمان مع احتمال التحيُّز العرقي إلى جانب تأثيرات سلبية أخرى غير مقصودة. وتشكك هذه الورقة في الجدوى الاقتصادية لهذه الممارسات، كما أنها تثير القلق حيال الطريقة الأبوية التي تنتهج في ما يتعلق بعوامل الاختطار التي قد يتم تحديدها. ولا ينبغي تضمين التقييمات الصحية إلا عندما تكون ملائمة لبيئة العمل، ومن ثم ينبغي التخلي عن الفحوصات السابقة للتوظيف وتحرِّي تعاطي المخدرات، حيث قد يكون مجرد استيفاء استبيان خاص بالتقييم الصحي كافياً. وينبغي على مقدِّمي الرعاية الصحية المهنية تقديم المشورة حول انطباق المعايير البدنية أو النفسية غير المتعلقة بالقيام بوظائف العمل الأساسية. ويوصى بالوصول إلى اتفاق في الآراء حول أفضل الممارسات في هذا المجال مع النظر في جمع المعطيات ذات الصلة بالممارسات السابقة للتوظيف.

References

1. Cox RAF, Edwards FC, Palmer K. *Fitness for work: the medical aspects*, 3rd ed. Oxford: Oxford Medical Publications; 2009.
2. Serra C, Rodriguez MC, Delclos GL, Plana M, Gómez López LI, Benavides FG. Criteria and methods used for the assessment of fitness for work: a systematic review. *Occup Environ Med* 2007;64:304-12.
3. Carter T. The application of the methods of evidence based practice to occupational health. *Occup Med (Chic Ill)* 2000;50:231-6.
4. Franco G. Evidence-based decision making in occupational health. *Occup Med (Chic Ill)* 2005;55:1-2.
5. Doust J, Del Mar C. Why doctors use treatments that do not work? *BMJ* 2004;328:474-5.
6. Harris JS, Glass L, Mueller K, Genovese E. Evidence-based occupational medicine. *Clin Occup Environ Med* 2004;4:341-60.
7. Whysner JA, Chase KH. In: McCunney, RJ. *Risk assessment in the workplace*. Philadelphia, PA: Lippincott, Williams and Wilkins; 2003.
8. Lohiya GS, et al. The futility of universal pre-employment chest radiographs. *J Natl Med Assoc* 2006;98:2019-23.
9. Hessel PA, Zeiss E. Evaluation of the periodic examination in the South African mining industry. *J Occup Med* 1988;30:580-6.
10. de Kort WL, Uiterweer HW, van Dijk FJ. Agreement on job fitness for a job. *Scand J Work Environ Health* 1992;18:246-51.
11. De Raad J, Redekop WK. Analysis of health factors as predictors for the functioning of military personnel. *Mil Med* 2005;170:14-20.
12. de Kort WL, van Dijk FJ. Preventive effectiveness of pre-employment medical assessments. *Occup Environ Med* 1997;54:1-6.
13. Shepherd J. Pre-employment examinations: how useful? *J Am Board Fam Pract* 1992;5:617-21.
14. Murphy MB. Blood pressure and fitness for work. *Am J Hypertens* 1992;5:253-6.
15. Hinkle LE, Whitney LH, Lehman W, Dunn J, King BBR, Plakun A, et al. Occupation, education and coronary artery disease. *Science* 1968; 161:238-46.
16. Rosenstock L, Cullen MR. *Textbook of clinical occupational and environmental medicine*. Philadelphia, PA: WB Saunders; 1995.
17. Mohr S, Gochfield M, Pransky G. Genetically and medically susceptible workers. *Occup Med (Chic Ill)* 1999;14:595-611.
18. Hansotia P. Seizure disorder, diabetes mellitus, and coronary vessel disease: considerations for the older driver. In: Reitchin SM, ed. *Clinics in geriatric medicine*. Philadelphia, PA: WB Saunders; 1993.
19. Collings GH. The pre-employment examination – worth its cost? *J Occup Med* 1971;13:422-6.
20. Lowenthal G. Medical center worker placement screening: a follow-up study. *J Occup Med* 1986;28:451-2.
21. Bennett G. Medical-cause accidents in commercial aviation. *Eur Heart J* 1992;13:13-5.
22. McGregor A. Fitness standards in airline staff. *Occup Med (Chic Ill)* 2003;53:5-9.
23. Popper SE. Incorporating occupational medicine methodology into military fitness for duty and readiness issues. *Aviat Space Environ Med* 1997; 68:740-5.
24. Nethercott JR. Fitness to work with skin disease and the Americans with Disabilities Act of 1990. *Occup Med (Chic Ill)* 1994;9:11-8.

25. Chau N, Bourgkard E, Bhattacherjee A, Ravaud JF, Choquet M, Mur JM, et al. Association of job, living conditions and lifestyle with occupational injury in working population: a population-based study. *Int Arch Occup Environ Health* 2008;81:379-89.
26. Glozier N, Hough C, Henderson M, Holland-Elliot K. Attitudes of staff toward co-workers returning from psychiatric and physical illness. *Int J Soc Psychiatry* 2000;52:524-34.
27. Stansfeld SA, Fuhrer R, Shipley MJ, Marmot MG. Work characteristics predict psychiatric disorders. *Occup Environ Med* 1999;56:302-7.
28. Pattani S, Constantinovici N, Williams S. Who retires from the NHS and what does it cost? A national cross-sectional study. *BMJ* 2001;322:208-9.
29. Kessler M, Mcongagle P, Zhao R. *Depression and gender*. Rockville, MD: Agency for Health Care Policy and Research; 1994.
30. Poole CJM. Can sickness absence be predicted at the pre-placement health assessment? *Occup Med (Chic Ill)* 1999;49:337-9.
31. Smedley J, Egger P, Cooper C, Coggon D. Prospective cohort study of predictors of incident low back pain. *BMJ* 1997;314:1225-8.
32. Robbins DB. Psychiatric conditions in worker fitness and risk evaluation. *Occup Med (Chic Ill)* 1988;3:309-21.
33. Anthony WA, Jansen MA. Predicting the vocational capacity of the chronically mentally ill. *Am Psychol* 1984;39:537-44.
34. Sheik K, Mattingly S. Factors associated with completion of employment rehabilitation courses. *Occup Med (Chic Ill)* 1981;31:16-8.
35. Judge WJ. Workplace drug testing's mixed success. *Behav Healthc* 2007; 27:14-6.
36. Shahandeh B, Coborn J. *Ethical issues in workplace drug testing in Europe: professional studies of drug tests*. Geneva: International Labour Organization; 2003.
37. French MT, Roebuck MC, Alexandre PK. To test or not to test: do workplace drug testing programs discourage employee drug use? *Soc Sci Res* 2004; 33:45-62.
38. White T. Drug testing at work: issues and perspectives. *Subst Use Misuse* 2003;38:1891-902.
39. Bennet G. Civil aviation. In: Cox RAF, Edwards FC, McCallum RI, eds. *Fitness for work: the medical aspects*. New York, NY: Oxford Medical Publications; 1994.
40. Donoghue AM. The calculation of accident risks in fitness for work assessments. *Society of Occupational Medicine* 2001;51:266-71.
41. Franco G. Evidence-based medicine and evidence-based occupational health. *Scand J Work Environ Health* 2003;29:78-9.