Exposure Assessment of Low Back Disorders: Assessment Criteria for Manual Handling Tasks

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1 INTRODUCTION

Among the important intervention methodologies in the field of ergonomics is how to assess the individual probability of contracting dorsolumbar spinal disorders due to manual load handling. Right now, owing to the variety and complexity of the organizational, environmental, and personal factors which determine the risk, it appears quite a complex assessment to make.

The term "exposure assessment" may be more appropriate. By identifying and quantifying the variety of possible major risk factors and their "integrated evaluation," it is possible to identify the degree of potential harmfulness of a given task, and to guide the preventive measures (risk management).

An extremely simplified interpretation of the assessment concept has become standard practice in workplaces and other applications. For example, load handling may be assessed solely on the basis of the weight of the load (perhaps referred to national regulations and standards). This is widespread practice in different countries; in fact, when a weight limit is introduced in the legislation, it is even possible to come up with the simplification that all objects weighing less than the weight limits may be handled in "safety!"

This level of simplification means the researcher has to redefine the requirements for assessment validity and applicability, leaving aside the rigors of a sophisticated scientific approach as a prerogative of research elites but also opposing the oversimplification demanded by operators in the field. Examining the variety of documents (guidelines, standards, operational handbooks) produced in the meantime, the requirement of proposing scientifically valid and practically applicable exposure assessment models has been widely acknowledged and largely solved.

2 LOAD LIFTING ASSESSMENT

As regards assessment of manual load exposure to lifting, most proposed models are based on the NIOSH equation published in 1981 (NIOSH 1981) and revised in 1993 (Waters *et al*. 1993). This occurs via major adaptations and changes in the original models; however, the existence of a common design is clear, thus making those models the most suitable to achieve the desired synthesis between scientific research basis and operative application. Actually the NIOSH model offers considerable advantages:

- It is supported by valid and diversified scientific bases (NIOSH 1981).
- It contemplates a large number of possible major risk factors.
- It summarizes in a synthetic index the more complex assessment process (lifting index as the ratio between weight actually lifted and the specifically recommended weight).
- It defines, albeit roughly, the degree of protection assured to a generic working population.

But adopting the NIOSH model to make assessments in the field of manual handling tasks did pose some problems. Here are three of them.

2.1 Caution May Be Tempered Using Empirical Data

The American authors themselves (Waters *et al*. 1993) emphasize that the procedure is not applicable in some situations; such caution is quite understandable from a strictly scientific viewpoint, but in some cases it may be overcome by making assumptions based on empirical data. Suppose the load is lifted with one arm only, perhaps this could be included by introducing a further multiplication factor of 0.6.

If lifting is carried out by two or more operators, always in the same workplace, maybe treat the weight actually lifted as the weight of the object divided by the number of operators, and use a further multiplication factor of 0.85 to obtain the recommended weight. Such further adaptations of the method (only one arm, more than one operator) are based on highly empirical data and not on experiments carried out following strictly scientific procedures. But without them, many problems would remain unsolved.

2.2 Multiple Tasks Need More Complex Analysis

In many working situations, the same group of workers have to carry out different load tasks often in the same workshift. The difference is the result of many different factors (nature of the object, different areas of loading and unloading, work organization procedures). Moreover, the different lifting tasks may be irregular in a given period of time in the workshift (e.g. in a warehouse with picking activities) or according to established time sequences (e.g. when an operator works every 1–2 hours on an assembly line, first loads the line, then unloads the finished products, and then packs them). In such cases the analytical procedure for each task is not suitable to summarize the overall exposure of the worker to load lifting. Therefore these cases require an analytical procedure for multiple tasks, which is obviously more complex. NIOSH has made a proposal for analyzing mixed multiple tasks, founded on the idea of calculating a synthetic lifting index for multiple tasks based on the index for the more overloading task, increased by values derived from the other tasks considered.

2.3 Nonindustrial Tasks Are Not Well Modeled

The NIOSH assessment procedure is not well suited to application in various working sectors (typically nonindustrial sectors), sometimes on account of the characteristic of the lifted load, the great variability of lifting tasks, their frequent association with other manual handling tasks (trolley pulling or pushing), and finally the presence of other risk factors for the lumbar spine (e.g. whole body vibrations). Agriculture, transport and delivery of goods, and assistance to individuals who are not self-sufficient are typical examples. In these situations, though the NIOSH lifting index is useful, validated procedures for integrated exposure assessment are not yet available, hence the need for further research and proposals on specific simplified exposure assessment procedures aimed at managing risk factors.

3 CONCLUSION

Researchers have yet to complete and verify the data on degree of protection associated with the adoption of different weight constants and with reference to different targets of the adult working population. Therefore a more precise definition becomes essential, especially in order to better establish large-scale prevention strategies which will be sufficiently well defined to account for the makeup of the working population (males and females, young and elderly, healthy and nonhealthy).

The NIOSH lifting index does not seem to be a complete risk index; it is still only an exposure index. Support for the NIOSH index as a risk index perhaps lies only in the (collective) probability of acute lumbago. In the future, epidemiologic studies will have to be developed to ascertain its predictability for degenerative chronic spinal diseases, due to biomechanical overload.

Some countries have adopted weight constants different from those originally proposed (23 kg), although they have retained the calculation procedures for the main multiplication factors in the Waters (1993) formula. This operation, although acceptable for immediate application, may not be fully justified from a strictly scientific and technical viewpoint. If weight constants are adopted other than those originally proposed, it will be necessary to redefine the terms for calculating each multiplication factor and then to decide on the necessary adjustments.

It has been debated that in some working situations, beside the multiple load lifting tasks assigned to a group of workers, they perform many other manual handling tasks such as pulling and/or pushing manual trolleys or carrying loads over long distances. Waters *et al*. (1993) states that its lifting index cannot be applied in these cases. Therefore an integrated assessment procedure needs to be developed for such complex situations, probably by extending the procedure for analyzing multiple lifting tasks.

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Exposure Assessment of Low Back Disorders: Criteria for Health Surveillance

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1 INTRODUCTION

Health surveillance observes the state of health of a population and its individuals (usually with respect to a specific health effect). It makes these observations over time and assesses their compatibility with exposure to one or more occupational risk factors. Health surveillance is implemented in industrialized countries in a great variety of ways, depending on specific cultures, regulations, and the development of social security systems. For example, there are countries where data on the health of individuals and workers is systematically collected, and although not always reliable or relevant, it may be used to implement processes for so-called passive health surveillance.

In other countries such current statistics are totally lacking, at least as regards work-related musculoskeletal disorders, therefore it is impossible to use or define passive health surveillance procedures. On the other hand, attention should be drawn to the extremely high number of workers potentially exposed to risks associated with manual material handling; this is why active health surveillance strategies must be developed that are suitable for monitoring vast numbers of workers, and also acceptable from the viewpoint of costs and human resources.

2 ACTIVE HEALTH SURVEILLANCE

2.1 A Three-Step Procedure

2.1.1 Step 1

All exposed subjects receive questionnaires or anamnestic interviews according to models that are already available in the literature (Kuorinka *et al*. 1987; Occhipinti *et al*. 1988). These tools are aimed at collecting data on more recent symptoms and disorders (generally over the past 12 months), and should also allow classification according to intensity or severity levels for diagnostic purposes or subsequent preventive measures. In other words, well-defined criteria for interpreting the total data collected on symptoms are recommended in order to unequivocally classify the investigated effects.

2.1.2 Step 2

The second step envisages a clinical examination of the spine only for subjects classified as positive in the previous anamnestic survey. This examination can be made by the occupational physician in the company medical department using a standardized set of specific clinical tests and maneuvers reported in the literature (NIOSH 1988; Occhipinti *et al*. 1988; Hagberg *et al*. 1995).

2.1.3 Step 3

The third step applies to those subjects, identified in steps 1 and 2, requiring more specialized tests (neurological, orthopedic, etc.) or instrumental tests (image diagnostics, EMG, etc.) in order to complete the individual diagnostic procedure.

2.2 Frequency and Goals

The frequency of generalized health surveillance (steps 1 and 2) may be established as required, according to relative exposure indexes as well as health results obtained in the latest round of examinations. Generally speaking, since health surveillance is concerned with slowly evolving chronic degenerative diseases, checks every 3–5 years are usually adequate. There may be exceptions when exposure is heavy and/or drastic changes in working procedures are under way; then more frequent monitoring of health effects may be advised.

One of the goals of health surveillance, from a collective viewpoint, is to check whether in a given working population, exposed to a specific risk, the occurrence of disease is other than expected. For instance, it is interesting to know whether in the same working population the occurrence of undesired effects (e.g. acute back pain, disk herniations) is markedly different from the rest of the working population not exposed to the specific occupational risks. To make such comparisons, generally by inferential statistics, adequate reference data must be available on the whole working population or at least its representative specimens.

Another goal of specific health surveillance at individual level is the earliest possible identification of subjects