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The use of the portable ergonomic observation method (PEO) to monitor the sitting posture of schoolchildren in the classroom

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Abstract

Contrary to common belief, back pain amongst young people is a frequent phenomenon. Epidemiological studies have found high prevalence rates of back pain amongst schoolchildren. The investigation reported here aims to validate children's self-reporting and the observation of sitting postures to establish the intensity, duration and frequency of exposure in the classroom. The sitting postures of 18 children were recorded using three methods, the portable ergonomic observation method (PEO), video analysis and self-report. The three methods were compared. PEO was significantly correlated with video analysis of the sitting postures after development of the method. Self-report was not significantly correlated with video analysis of the sitting postures. Therefore PEO was selected as the main observation tool in further analysis of children's sitting posture in schools in South-East England as part of a large research programme investigating back pain amongst schoolchildren.

Keywords: Posture; Sitting; Observation

1. Introduction

Back pain is a significant burden on industrialised countries. If the symptoms and causes of back pain could be identified at an early stage, the opportunity for remedial action would be improved. It has been shown that a strong predictor of having future back pain is a previous history of such symptoms (Troup et al., 1987). A large portion of adult sufferers report a first onset of back pain in their early teenage years or in their 20s (Papageorgiou et al., 1996). It is commonly perceived that back pain amongst young people is uncommon (Turner et al., 1989). However, epidemiological studies have found high prevalence rates of back pain (Brattberg and Wickman, 1992; Troussier et al., 1994). Mandal (1994) suggests that a seated person has a hip joint flexion of about 60° and the pelvis has a sloping axis, so that the lumbar region then exhibits a convexity, or kyphosis. This is supported by Schoberth (1962), who found from X-ray examinations of 25 people sitting upright, an average 60° hip flexion and 30° lumbar flexion. Storr-Paulsen and Aagaard-Hansen (1994) found that in one school, children remained seated between 19 and 90 min during a 90 min double lesson, with older children sitting for longer periods of time and most of the children sitting on average for more than 60 min. Of the time spent seated, 57% was spent leaning forward (e.g. writing or painting) with 43% spent doing backward leaning activities (e.g. looking at blackboard or reading). School chairs and desks are designed for children to sit and work with a 90° flexion of the hip joint and a preserved lumbar lordosis, as recommended by Snorrason (1968). It seems that children do not use school furniture in this way.

The study reported in this paper is part of a large research programme investigating back pain amongst children in schools in two areas of England (i.e. Surrey and Manchester). Aims of the whole study are to:

- identify the extent of back pain experienced by schoolchildren, aged 11–14;
- establish any physical risk factors, which may be present in schools; and
- provide advice to prevent problems arising in the future,

in association with the Arthritis Research Campaigns' Epidemiology Unit University of Manchester.

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As a sub-section of this, the aims of the study reported here are:

- validation of methods to record the sitting posture of schoolchildren in the classroom; and
- minimising disruption in normal lessons during posture recording.

Direct observation of children in the classroom was considered the most suitable method to use in schools to record posture (Murphy and Buckle, 2000). This paper describes the calibration of the observer and the development of the portable ergonomic observation method (PEO) (Fransson-Hall et al., 1995), for use in the classroom to observe the sitting posture of schoolchildren. PEO was used in the study as the method records the posture of the children in real time in the classroom. Time-sampled observations such as Posturegram (Priel, 1974) and OWAS (Karhu et al., 1977) only provide an estimate of this information whereas real-time observations provide information about the intensity, duration and frequency of the posture.

1.1. Ethics

Permission was granted from the Director of Education for Surrey schools, The Ethics Committee of the University of Surrey and the head teacher of the school involved. The parents and children were each sent a consent letter informing them of the study with the option to withdraw at any stage.

2. Calibration process

This calibration work involved direct measures in the laboratory, at this stage there was very limited access to schools. Measurements were taken of a group of subjects in the laboratory using the Lumbar motion monitor (LMM) (Marras et al., 1992) and a goniometer. This equipment was used to set reference angles. The angles were those used in the PEO system. The observer spent a total of 10 h in the laboratory over a period of 1-week observing a subject bending while wearing the LMM to trunk flexions of 20° and 45°. Six female and five male students at the University of Surrey were then observed standing while wearing the LMM. The students were directed by the observer to bend forward to the point where the observer judged the subject's trunk to be at more than 20° or 45° flexion. A total of 110 observations, 60 observations at more than 20° trunk flexion and 50 observations at more than 45° trunk flexion were made. During the observations, a second observer recorded the angle of trunk flexion from the LMM and the angle of trunk flexion using a goniometer. The flexion angles were recorded but not fed back to the observer. At this stage it was decided that neck flexion $>30^\circ$ as used in the PEO system would be changed to neck flexion $>20^\circ$ to be consistent with measurements of the trunk. The LMM and gonimeter were used, as they were quick to use and analyse.

2.1. Calibration results

The observations showed reasonable agreement with the LMM (72%) and goniometer (84%). The improved agreement between observations and the goniometer could be due to variability in the positioning of the LMM on subjects. Therefore, trunk flexion categories of $<20^\circ$ and $<45^\circ$ were included in the PEO system to record the sitting postures of children in the classroom environment.

3. Methods for main data collection

18 schoolchildren, nine females and nine males aged 11–14 at a large secondary school in Surrey were studied; posture was recorded using both PEO and video. At the end of each lesson, the children were given a short questionnaire relating to sitting posture during the lesson. The lessons recorded included: Textiles, English, History, Geography, Science (computer-based), Biology, Religious Education and Art. The lessons were chosen by the contact teacher at the school and were chosen to minimise disruption to lessons and ensure cooperation by the teachers involved. Recording took place in both morning and afternoon lessons. The video and computer equipment were set up at the back of the classroom and focused on one pupil per 30-min session. The video camera was set between 1.5 and 2.5 m from the subject directly in the sagittal plane with the thigh and trunk visible at all times.

3.1. PEO

Observations of body postures were made in real time directly in the classroom using a Viglen Dossier 486 laptop computer. 18 children were recorded for 30 min each. The PEO screen set-up and the postures recorded were as shown in Fig. 1.

When the observer presses the pre-defined keys, continuous visual feedback is provided on screen by the posture being highlighted. The start of the event is recorded and when the same key or a mutually exclusive key is pressed, the end of the event is recorded. At the end of the observation, the PEO software gives a read out of the percentage of time spent in the recorded postures, the number of registrations of the postures, and the time of the start and finish of each event.

The categories included in the PEO system are selected according to risk factors in the literature