Ergonomic Assessment of Patient Orthodox Lifting Technique Using Digital Human Modeling

C Ha, W Cao, and MT Khasawneh

Department of Systems Science and Industrial Engineering
State University of New York at Binghamton
Binghamton, NY 13902, USA

Corresponding author's Email: mkhasawn@binghamton.edu

Abstract: Nursing staff at hospitals are often exposed to the harm of work-related musculoskeletal disorders (WMSDs) during patient handling activities. WMSDs, including back injuries, are perhaps among the most expensive but most preventable workplace injuries in the United States. The American Nurses Association (ANA) reports that ergonomic injuries occur in nurses personnel at a rate which is twice that found in the general working population. Therefore, the objective of this study is to apply a comprehensive assessment for the Orthodox lifting technique using digital human modeling (DHM). More specifically, this research studies the impact of patient weight and height (PWH), clinical staff weight and height (CSWH), and clinical staff gender (CSG) on the clinical staff's lower back compression force (LBCF). Furthermore, the impact of postural variables, such as elevation and rotation, was evaluated using Comfort Assessment (CA). The virtual environment is created using the JACK 7.1 software. Analysis of Variance (ANOVA) is used to identify the CA main factors and their interactions that have significant impact on the clinical staff's LBCF. The results showed that most female staff could be in a high risk of developing WMSDs when lifting relatively heavy patients, perhaps due to their biological structure (muscle strength). In general, LBCF changes significantly with changes in PWH. For example, female clinical staff in the 50th and 95th percentiles obtained the largest values of LBCF (6423N and 6729N, respectively) when lifting 95% PWH patients. Conversely, male staff experience less LBCF while lifting subjects with equivalent PWH. The least LBCF value appears in clinical staff in the 5th percentile when lifting a 5% PWH (3524N). Interestingly, CSWH did not have any significant impact on LBCF and CA results. Therefore, this research showed that CSG and PWH would be the most influential factors when adopting the Orthodox patient lifting technique. Additionally, comfort analysis (CA) results provide a clearly angle for identifying those human parts which would easily experience discomfort during patient handling and lifting process. This research further demonstrated the usability of DHM in ergonomic assessments of patient handling activities in healthcare settings.

Keywords: Patient Orthodox Lifting, Digital Human Modeling, Ergonomics, Lower Back Analysis