EFFECTS OF COMPLIANT FLOORING SYSTEMS AND RESIDENT WEIGHT ON HAND FORCES WHEN PUSHING FLOOR-BASED LIFTS AND WHEELCHAIRS AMONG LONG-TERM CARE STAFF

Chantelle C. Lachance[1], Alexandra M.B. Korall[1], Colin M. Russell[1], Shannon I. Johnson[2], Fabio Feldman[3], Stephen N. Robinovitch[1], and Dawn C. Mackey[1]

[1]Simon Fraser University, Canada
[2]Royal City Manor by Revera, Canada
[3]Fraser Health Authority, Canada

Preliminary clinical findings suggest that compliant flooring may reduce the incidence and severity of fall-related injuries in long-term care (Knoefel et al., 2013) and acute-care settings (Drahota et al., 2013). However, there is concern that manoeuvring wheeled equipment on compliant flooring could expose care staff to potentially harmful pushing forces (Drahota et al., 2013; Wynn et al., 2011). We measured the external resultant hand forces (initial and sustained) required for female direct care staff to push two floor-based lifts (conventional manual and motor-driven) (n=14) or a wheelchair (n=14), loaded with passengers of average (67 kg) and ninetieth percentile (90 kg) resident weights, over four flooring systems: *concrete + vinyl, compliant (1" SmartCells) + vinyl, concrete + carpet, and compliant + carpet*. We observed an interaction between lift type and floor system for initial ($p < 0.001$) and sustained ($p < 0.001$) forces. Independent of resident weight, mean forces were lower for the motor-driven lift than the conventional lift on all flooring conditions (by 34.8 – 74.4 N for initial forces and by 14.1 – 64.5 N for sustained forces). With the vinyl overlay, initial forces were higher on compliant than concrete subflooring when using the conventional lift (mean difference = 44.7 N, 47.7% increase, $p < 0.001$) and motor-driven lift (29.8 N, 45.8% increase, $p < 0.001$). Similarly, with the vinyl overlay, sustained resultant forces were higher on compliant subflooring than concrete subflooring when using the conventional lift (39.0 N, 88.2% increase, $p < 0.001$) and motor-driven lift (9.7 N, 29.0% increase, $p < 0.001$). With the carpet overlay, the differences between compliant and concrete subfloors were less pronounced than with the vinyl overlay for the conventional lift ($F_{initial}$: 23.0 N higher, 14.9% increase, $p < 0.001$; $F_{sustained}$: 15.6 N higher, 18.7% increase, $p < 0.001$) and absent when using the motor-driven lift ($F_{initial}$: $p = 0.975$; $F_{sustained}$: $p = 0.999$). We also observed an interaction between resident weight and lift type for initial ($p = 0.004$) and sustained forces ($p < 0.001$). Independent of flooring system, $F_{initial}$ was 18.6 N higher (13.5% increase, $p < 0.001$) and $F_{sustained}$ was 11.7 N higher (14.3% increase, $p < 0.001$) for the ninetieth percentile weight than the average weight for the conventional lift. In contrast, there were no differences in $F_{initial}$ ($p = 0.200$) and $F_{sustained}$ ($p = 0.100$) between the average and ninetieth percentile weight conditions for the motor-driven lift. Similar trends were observed when participants pushed the wheelchair. In summary, this study found that compliant subflooring increased the external hand forces required for female direct care staff to push floor-based lifts and wheelchairs compared to concrete subflooring, and these increases in force were greater when pushing over vinyl than carpet overlay. This study also demonstrated that a motor-driven lift substantially reduced push forces compared to a conventional manual lift. Thus, motor-driven lifts may help to prevent work-related musculoskeletal injuries in long-term care facilities, especially in facilities with compliant flooring.

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