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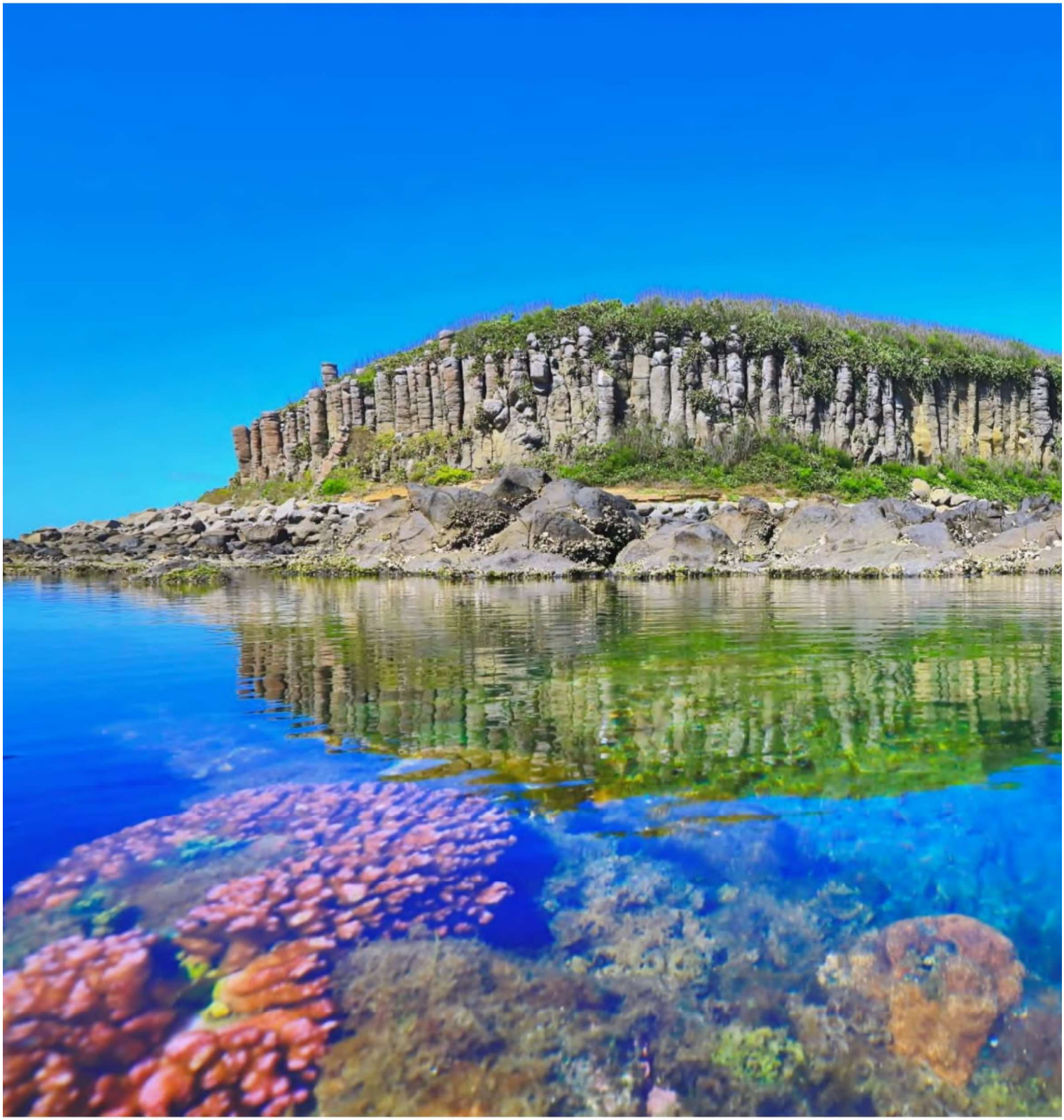
ABSTRACT BOOK



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The effect of delivery van ingress strategy on knee joint moments

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Introduction

Delivery van ingress is a complex movement task [1]. In particular, the first step onto the approximately 45 cm high footstep, during which the body is reoriented in the direction of the cockpit (Figure 01), suggests high non-sagittal knee joint moments [2], which may also contribute to overload injuries. An optimized movement strategy may help to reduce lower extremity loading. Therefore, this study aimed to investigate the effect of two different hand supports (A-Pillar handhold vs. steering wheel) on knee joint loading during vehicle ingress.

Figure 01: Hand and foot positions during ingress are marked for the basic pattern (green) and the differentiation in either WHEEL or HANDLE strategy (grey).

Methods

A cross-sectional single cohort study design identified the effect of delivery van ingress strategy on knee joint moments. 30 participants (78 ± 9 kg, 1.83 ± 0.07 m) entered a full-size physical mock-up of a standard delivery van cockpit. Contact on the instrumented footstep (Kistler, Winterthur, CH) was made with the left foot (Figure 1). Two different movement strategies were investigated. Participants pulled themselves into the cockpit with their left hand, either on the steering wheel ("WHEEL") or the A-pillar handle ("HANDLE"). Knee joint loading was modeled using an inverse dynamic approach (AnyBody Modeling System, Aalborg, DK) based on kinematic data of the lower extremities (Vicon, Oxford, UK) and ground reaction forces at the intermediate step. Paired sample t-tests ($\alpha = 0.05$) were run to compare the effects of WHEEL- and HANDLE-centered ingress strategy on peak knee-flexion, -adduction and -internal rotation moments.

Results

The HANDLE strategy resulted in peak knee adduction moments of 0.37 ± 0.08 Nm/(kg*m) during the intermediate left foot step. In comparisson the WHEEL strategy increased knee adduction moments significantly by 14% to 0.44 ± 0.01 Nm/(kg*m). The knee internal rotation moment was significantly reduced by 16% when using HANDLE (0.11 ± 0.04 Nm/(kg*m)) in comparison to WHEEL (0.14 ± 0.05 Nm/(kg*m)). The maximum knee joint flexion moments for HANDLE (0.57 ± 0.10 Nm/(kg*m)) and WHEEL (0.56 ± 0.12 Nm/(kg*m)) were comparable.

Discussion

The main finding of the study is, that using the A-pillar handle is an effective measure to reduce knee joint loading during delivery van ingress. Compared to a WHEEL-centered ingress strategy, especially non-sagittal joint moments were significantly decreased.

A possible mechanism for decreased adduction and internal rotation moments is, that the handle at the A-pillar allows a more upward-directed pulling than the laterally positioned steering wheel [2]. These findings suggest a simple intervention to reduce knee joint loading for the growing occupational group of delivery drivers.

Acknowledgments

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References

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