

# **Designing of the K-LEXO (Korea Lower-limb Exoskeleton) for Elderly Agricultural Workers**

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## **Abstract**

This study aims to develop a wearable lower-limb exoskeleton (K-LEXO) to reduce the physical loads on elderly agricultural workers. Farming often involves repetitive, awkward postures, such as squatting and deep knee flexion, which contribute to lower-limb musculoskeletal disorders. Although industrial exoskeletons help reduce loads on specific muscle groups, their application in agriculture remains limited due to safety and wearability issues. To address these challenges, a systematic development process was employed, including: (1) field and market analysis, (2) conceptual and structural design, (3) anthropometric parameter definition, (4) prototype development, and (5) usability testing. A total of 11 prototypes were created. The initial version (V-1.1) exhibited several limitations, including heavy weight, insufficient fixation strength, and knee angle adjustments. Versions V-1.2 and V-1.3 addressed these issues by applying anthropometric data and incorporating a BOA fastening system and waist belt for stability. Beginning with the V-2 series, 3D human scan data were incorporated to enhance conformity to human body geometry, and the main frames were repositioned from the posterior to the anterior side of the lower limbs to improve wearability and stability. The V-3 series underwent further refinement of the frame to more accurately replicate the thigh-calf angles, culminating in the final prototype (V-3.3), which featured a body-conforming structure suitable for field testing. This study lays the foundation for future research on the practical applicability and potential benefits of lower-limb exoskeletons in agricultural work.

## **Keywords**

K-LEXO (Korea Lower-limb Exoskeleton), Work-Related Musculoskeletal Disorder (WMSDs), Usability Test, Agricultural Work, Elderly Workers

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