

博士学位論文内容要旨
Abstract of Dissertation

専攻 Course	応用環境システム学	氏名 Name	諸星 亮
論文題目 Title	青年期の非特異的腰痛と身体的要因の関係		

Low back pain (LBP) is one of the most prevalent musculoskeletal disorders worldwide. Approximately 85% of LBP cases are classified as nonspecific, meaning that no clear pathological cause can be identified. Beyond its effects on individuals, LBP contributes to substantial economic burdens through increased healthcare costs and lost labor productivity. Once developed, LBP tends to recur and become chronic, further amplifying its detrimental effects. When LBP occurs in adolescents and young adults (AYAs), it increases the risk of LBP persisting into adulthood. Therefore, implementing preventive strategies during adolescence and young adulthood is crucial for long-term musculoskeletal health.

Many physical and behavioral factors have been associated with the development of LBP, including prolonged use of digital devices (e.g., personal computers and smartphones), poor posture, decreased muscle flexibility, and insufficient physical activity. However, studies examining the relationships between these factors and nonspecific LBP in AYAs have yielded inconsistent results. Recently, heart rate variability (HRV) has been identified as a promising objective indicator for evaluating autonomic nervous system (ANS) function in individuals with LBP. As such, HRV may contribute to more comprehensive and quantifiable approaches to LBP assessment.

The primary objective of this study was to investigate the prevalence and characteristics of nonspecific LBP among AYAs. The secondary objective was to explore LBP's associations with muscle strength, joint flexibility, physical activity levels, sedentary behavior, posture, smartphone usage habits, and ANS function assessed through HRV.

In Chapter 2, university students completed a self-administered questionnaire to investigate the prevalence of LBP, awareness and attitudes toward prevention, and patterns of smartphone use. The results revealed that 48.5% of students reported LBP, with many also reporting comorbid symptoms such as shoulder stiffness. Despite this high prevalence, only 10.4% of participants engaged in any form of LBP prevention strategies, and only 13.5% had received education on back pain. In contrast, 53.2% of students expressed a perceived need for LBP prevention strategies, and 63.3% showed an interest in learning more about LBP, suggesting that it is an issue that concerns many AYAs, despite their limited preventive behaviors. Furthermore, students who used their smartphones for more than two hours per day reported a significantly higher prevalence of LBP compared to those who used them for less than two hours per day. The prevalence of LBP was highest in students who used their smartphones for four or more hours per day and adopted poor posture during use. These results suggest that both prolonged smartphone use with poor posture may contribute to the development of LBP in AYAs.

Chapter 3 explored the relationship between physical function and LBP. Physical function was assessed through three measures: grip strength, sit-and-reach flexibility, and trunk curl-ups, which represented overall strength, flexibility, and core endurance, respectively. Logistic regression analysis revealed that individuals with subjective symptoms, such as shoulder stiffness or back tightness, were more likely to report LBP. Interestingly, among female students, those with greater sit-and-reach scores were more likely to report LBP, suggesting a potential association between greater flexibility and increased pain. Furthermore, students who reported regular exercise also had a higher prevalence of LBP. These results imply that certain exercise patterns or frequencies may contribute to LBP, underscoring the need to consider exercise type, intensity, and adequate recovery in future

prevention strategies.

Detailed physical and physiological assessments were conducted in Chapter 4. The evaluations included the Japanese LBP Evaluation Questionnaire (JLEQ), palpation of the lumbar spinous process, and examination of the tenderness of the lumbar musculature. Participants were categorized into LBP and Non-LBP groups based on their symptoms and clinical condition. Joint range of motion assessments were conducted to evaluate flexibility, including trunk lateral flexion, hip flexion, ankle dorsiflexion, and the heel-to-buttock distance during knee flexion. While Chapter 3 assessed overall flexibility using the sit-and-reach test, Chapter 4 specifically examined hip extensor flexibility using the straight leg raise test. Physical activity and sedentary behavior were measured over a 24-hour period using wearable devices, eliminating the recall bias present in questionnaire-based assessments. Activity of the ANS was assessed using HRV analysis. The LBP group had significantly lower flexibility in the hip extensor, knee extensor, and ankle plantarflexor muscles compared with the Non-LBP group. Participants with LBP exhibited greater sympathetic activity and reduced parasympathetic activity, suggesting dysregulation of the ANS. Therefore, assessing ANS function using HRV may be a useful objective evaluation method for detecting LBP. Total physical activity and overall sedentary time were not significantly different between the LBP and Non-LBP groups. This suggests that the quantity of sedentary behavior may be less critical in influencing LBP than good posture and activities during sedentary periods.

Overall, nonspecific LBP in AYAs appears to be associated with multiple interrelated factors. These include reduced flexibility of the hip and knee extensors and ankle dorsiflexors, prolonged smartphone use with poor posture, and other subjective complaints such as shoulder and back stiffness. These results support the effectiveness of simple interventions, such as stretching exercises targeting the lower extremities, in preventing LBP in AYAs. Moreover, educational strategies that promote awareness of posture and limit prolonged smartphone use may be particularly beneficial. The findings also suggest that HRV may be a useful tool for the objective assessment of ANS function in AYAs with LBP. These findings serve as a foundation for future research into the development of evidence-based strategies to reduce the burden of LBP in both adolescence and later adulthood.