Developing Biomechanical Interventions for Major Depression: The Relationship Between Affective Processing and Gait Dynamics in Young Adults

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Summary

This study examined the relationship between affective processing and gait dynamics in 18 young adults. Participants completed psychological assessments, depressive and anxiety symptom measures and an emotional bias task. Then walked continuously along a 10-meter walkway making contact with a Kistler force plate during six passes. Higher anxiety scores were associated with increased gait force variability, while slower reaction times to sad stimuli correlated with greater vertical impulse and mediolateral force variability. These findings suggest that subtle mood disturbances influence gait and that biomechanical measures may serve as early indicators of emotional dysfunction, highlighting the potential for targeted interventions in motor and mental health.

Introduction

Major depressive disorder (MDD) affects about 13% of the population and is a leading cause of global disability [1]. In addition to mood disturbances, depression often involves motor symptoms like altered gait, slumped posture, and impaired balance, which are frequently overlooked [2]. Depressed individuals typically walk slower, take shorter strides, and exhibit greater postural instability. Emerging evidence suggests that motor functions are closely linked with cognitive processes, particularly those involved in affective processing. Affective processing refers to the way in which individuals perceive, interpret, and respond to emotionally salient information. It encompasses both immediate emotional reactivity and the subsequent cognitive evaluation of emotions. This study examines the relationship between affective processing, anxiety, depression, and gait in a non-clinical sample.

Methods

Eighteen young adults (age 19.5 ± 0.5 years) provided written informed consent and completed baseline assessments. Psychological measures included the Patient Health Questionnaire (PHQ-8) for depressive symptoms, the Generalized Anxiety Disorder-7 (GAD-7) scale for anxiety, and the CANTAB emotional bias task, which measured mean (RTMNS) and standard deviation (RTSDS) of reaction times for selecting "Sad." Biomechanical testing was conducted along a 10-meter walkway using a Kistler force plate (1000 Hz) embedded mid-walkway. Participants walked at a self-selected pace along the walkway six times continuously. Key gait events (initial contact and toe-off) were identified from the vertical force curve, and variables, including forces, impulse, and force variability (quantified as the standard deviation across foot contacts), were extracted. Spearman correlation analyses were used to assess relationships between psychological and gait measures.

Results and Discussion

PHQ-8 scores indicated minimal depressive symptoms, whereas GAD-7 scores (0 to 25), reflected varying levels of anxiety. Higher GAD-7 scores were significantly correlated with increased gait forces and variability, including peak anterior-posterior force ($r = .501$, $p = .034$), mean mediolateral force ($r = .468$, $p = .047$), peak variability in anterior-posterior force ($r = .636$, $p = .005$), and mediolateral force ($r = .481$, $p = .043$). Prolonged reaction times to sad stimuli (RTMNS) was positively correlated with vertical impulse variability ($r = .63$, $p = .006$) and mediolateral force variability ($r = .49$, $p = .041$), and RTSDS scores correlated with vertical impulse variability ($r = .46$, $p = .048$) and peak mediolateral force variability ($r = .57$, $p = .014$). These findings underscore a nuanced interplay between mood, affective processing, and motor control. The lack of significant correlations with PHQ-8 scores likely reflects the low severity of depressive symptoms in our cohort, suggesting that anxiety and its related affective processing may be more influential on gait dynamics. This pattern aligns with previous research indicating that cognitive influences, including affective reactivity, can have measurable effects on motor behaviour [3]. Such insights could have important implications for identifying early markers of motor variability in populations with heightened anxiety or altered affective processing.

Conclusions

Subtle variations in affective processing are linked to increased gait variability in young adults with minimal depressive symptoms. These results indicate that gait measures could serve as early markers of mood disturbances and support further exploration of biomechanical interventions to enhance both motor and mental health.

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References

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