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DIGITAL MEASURES OF GAIT AND BALANCE ACROSS MOTOR SUBTYPES OF PARKINSON'S DISEASE

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Abstract

Purpose: This study aimed to investigate differences in digital gait and balance measures between the postural instability/gait difficulty (PIGD) and tremor-dominant (TD) motor subtypes of Parkinson's disease (PD).

Methods: Seventy individuals with the PIGD subtype and fifty-one with the TD subtype (identified using the Stebbins criteria) wore eight inertial sensors while performing motor tasks assessing gait and balance domains, including postural sway, anticipatory postural adjustments (APAs), automatic postural responses (APRs), and limits of stability (LoS). Nonparametric analysis of covariance, controlling for age and disease duration, was used to compare groups.

Results: Compared to the TD subtype, individuals with the PIGD subtype demonstrated poorer performance in digital measures related to pace, turning, rhythm, and trunk movements during both single- and dual-task gait ($p < 0.01$), with no significant between-group differences observed in dual-task costs. No significant differences were found between groups in digital balance measures, including postural sway, APAs, APRs, and LoS ($p > 0.01$).

Conclusions: Digital gait measures differed between the PIGD and TD subtypes, whereas digital balance measures were largely comparable. These findings may support the standardization of digital assessments of gait and balance across PD motor subtypes and contribute to the development of subtype-specific rehabilitation strategies. Rehabilitation programs for the PIGD subtype should primarily focus on gait-related impairments, while balance training may be beneficial for all individuals with PD.

Keywords: Inertial Measurement Units, Gait, Postural Balance, Postural Instability/Gait Difficulty, Tremor-Dominant

CONCURRENT VALIDITY OF A CUSTOMIZED VIRTUAL REALITY MODULE ("B-OYUN") FOR CERVICAL RANGE OF MOTION AND JOINT POSITION SENSE ASSESSMENT: A PILOT STUDY

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Abstract

Purpose: This study aimed to investigate the concurrent validity of a newly developed Virtual Reality (VR) module ("B-Oyun") against a digital goniometer for assessing cervical range of motion (ROM) and joint position sense (JPS).

Methods: Ten participants (6 females, 4 males) with a mean age of 33.6±12.95 years were included. Cervical ROM and JPS were measured in six directions simultaneously using the "B-Oyun" module on a Meta Quest 3 headset and a reference digital goniometer. Intraclass Correlation Coefficients (ICC) with 95% confidence intervals (CI) and Bland-Altman bias (mean difference) values were calculated to determine agreement between the two methods.

Results: The VR module demonstrated good to excellent concurrent validity for cervical ROM, with ICC values ranging from 0.826 to 0.979. Bland-Altman analysis revealed low mean bias values for ROM, ranging from -1.74° to 3.00°. For JPS assessment, ICC values ranged from 0.714 to 0.980, indicating moderate to excellent agreement, with minimal mean bias values ranging between -0.01° and 0.91° across all planes. These findings indicate high consistency and narrow limits of agreement between the VR headset sensors and the digital goniometer.

Conclusions: The "B-Oyun" VR module could provide objective and valid measurements for cervical kinematic assessment. ICC values and minimal bias demonstrate that this customized VR platform could be a reliable alternative to conventional digital goniometry in clinical settings.

Keywords: Virtual Reality, Neck Pain, Range of Motion, Proprioception, Reproducibility of Results

REACTION TIME REVEALS COGNITIVE DECLINE: SENSOR-BASED ASSESSMENT IN MILD COGNITIVE IMPAIRMENT

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Abstract

Purpose: This study aimed to evaluate the relationship between cognitive functions and sensor-based reaction time measured using a portable light-based system (BlazePod) in individuals with Mild Cognitive Impairment (MCI).

Methods: A total of 62 individuals with MCI (30 males, 32 females) were included. Inclusion criteria were literacy, age 50–75 years, and preserved instrumental activities of daily living. Exclusion criteria included medications or supplements affecting cognition, neurological disease, or psychological disorders. Cognitive function was assessed using the Montreal Cognitive Assessment (MoCA) and Trail Making Test (TMT A–B). Reaction time, correct responses, and missed responses were measured using BlazePod sensors. Correlations were interpreted as negligible (<0.1), weak (0.1–0.39), moderate (0.4–0.59), strong (0.6–0.79), or very strong (0.8–1.0).

Results: Participants had a mean age of 63.3±7.60 years and a mean MoCA score of 19.8±3.23. MoCA scores showed moderate positive correlations with correct responses on the right (r=0.470) and left sides (r=0.453), and a strong negative correlation with left-side reaction time (r=−0.600). Longer TMT A and B completion times showed moderate negative correlations with correct responses on the right (TMT A: r=−0.455; TMT B: r=−0.381) and left sides (TMT A: r=−0.541; TMT B: r=−0.446), and weak-to-moderate positive correlations with missed responses on the right (TMT A: r=0.263; TMT B: r=0.370) and left sides (TMT A: r=0.427; TMT B: r=0.410).

Conclusions: Cognitive performance in MCI is associated with reaction time and response accuracy. Sensor-based assessments may help identify cognitive–motor impairments and support early screening and monitoring.

Keywords: Cognitive Dysfunction, Reaction Time, MCI

THE EFFECT OF TELEREHABILITATION-BASED DIAPHRAGMATIC BREATHING AND EXERCISE TRAINING ON PAIN, FUNCTIONALITY, AND QUALITY OF LIFE IN PATIENTS WITH CHRONIC NECK PAIN

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Abstract

Purpose: To investigate the effects of telerehabilitation-based diaphragmatic breathing and exercise training on pain, functionality, and quality of life in chronic neck pain (CNP).

Methods: This single-blinded, randomized controlled trial included 40 adults with CNP (≥3 months). Participants were randomized to an intervention group (diaphragmatic breathing and conventional exercises) or a control group (conventional exercises only). Both received telerehabilitation sessions three times a week for eight weeks. Assessments included VAS (pain), Neck Disability Index (functionality), and SF-12 (quality of life).

Results: Thirty-nine participants completed the study with no significant baseline differences in age, gender (78.9% vs 75% female), or BMI (25.13±4.91 vs 24.91±5.57; $p > 0.05$). After 8 weeks, both groups showed significant within-group improvements in VAS and NDI scores ($p < 0.001$), while SF-12 scores remained unchanged ($p > 0.05$). Furthermore, no statistically significant differences were found between the intervention and control groups at the post-treatment assessment ($p > 0.05$).

Conclusions: Telerehabilitation-based exercise protocols effectively reduce pain and improve functionality in CNP. While adding diaphragmatic breathing was not statistically superior to exercise alone, both are viable options for remote management.

Keywords: Neck Pain, Telerehabilitation, Breathing Exercises, Quality of Life, Pain Measurement

USER ENGAGEMENT WITH TURKISH-LANGUAGE INSTAGRAM CONTENT ON EXERCISE DURING PREGNANCY: ASSOCIATIONS WITH INFORMATION QUALITY AND RELIABILITY

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Abstract

Purpose: To evaluate the quality and reliability of Instagram content shared under the hashtag #gebelikteegzersiz and to examine their association with user engagement.

Methods: On March 08, 2026, the first 50 Instagram posts tagged with #gebelikteegzersiz were included in the analysis. The quality (Global Quality Score) and reliability (modified DISCERN instrument) of the posts were independently assessed by two physiotherapists. Post type, post age, and uploader information were recorded. The relationship between the number of likes and other variables was analyzed using a generalized linear model with a negative binomial distribution.

Results: The 52% of the posts were in post format and 48% were reels. The mean modified DISCERN and Global Quality Score values were 1.70±0.93 and 2.18±0.77, respectively, while the mean post age was 425.00±405.21 days. Inter-rater reliability was moderate-good for the modified DISCERN (ICC=0.78, 95% CI:0.61–0.87) and Global Quality Scores (ICC=0.74, 95% CI:0.55–0.86). In regression analysis, after adjusting for post characteristics, neither reliability nor the quality was significantly associated with the number of likes ($p>0.05$). Content creator ($\beta=1.115–1.613$; $p\leq0.045$) and post format ($\beta=1.494$; $p<0.001$) were significant predictors of engagement.

Conclusions: Instagram posts related to exercise during pregnancy appear to be influenced by post characteristics and content creator rather than the quality or reliability of the information. Therefore, in addition to encouraging healthcare professionals to produce accessible evidence-based content, efforts aimed at improving users' health literacy and critical evaluation skills on social media platforms may be necessary to promote more informed engagement with relevant information.

Keywords: Prenatal Exercise, Social Media, Health Communication, Online Health Information, Content Analysis

ASSESSING FIVE LIFE ESSENTIALS THROUGH WEARABLE AND DIGITAL TECHNOLOGIES IN TYPE 1 DIABETES

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Abstract

Purpose: To assess five life essentials, physical activity (PA), stress, blood glucose control, sleep, and metabolic regulation, in adolescents with type 1 diabetes using wearable and digital monitoring tools.

Methods: Twenty-one adolescents with type 1 diabetes (mean age: 14±3 years) were included in the study. PA and sleep parameters were obtained via Fitbit Sense wearable device. Stress levels were evaluated through the device's electrodermal activity sensor. Blood glucose was determined by a continuous glucose monitoring system. Basal metabolic rate was assessed by bioelectrical impedance analysis. Pearson correlation analysis was used to examine relationships between the measured parameters.

Results: The mean weekly step of the participants was 8211±3369 steps. The mean stress score was 76.52±6.54. The mean fasting blood glucose was 140±34 mg/dL. Average sleep duration was 6±1 hours per day. Basal metabolic rate was 1460±261 kcal. A moderate positive correlation was found between high intensity PA and Hba1c ($r=0.527$, $p=0.014$). No other significant correlations were observed between the measured parameters.

Conclusions: Life essentials in diabetes management include regular PA, stress management, blood glucose control, sleep quality, and metabolic regulation. Wearable technologies provide an effective way to monitor these domains in daily life. In this study, most life essential parameters were not related to each other. However, higher levels of physical activity were associated with glycemic control. These findings highlight the potential of wearable technologies to provide integrated lifestyle monitoring and support individualized diabetes management strategies.

Keywords: Health, Physical Activity, Wearable Devices

AI-BASED MOBILE SYSTEM FOR SELECTING TRADITIONAL GAMES BY ACTIVITY INTENSITY AND BODY REGION IN CHILDREN

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Abstract

Purpose: This study aims to develop a prototype artificial intelligence–supported mobile application that recommends traditional games based on targeted physical activity intensity and specific body regions

Methods: This study is conducted as a prototype development project. In the first phase, traditional children's games are systematically collected from the literature and cultural sources. Each game is being categorized according to estimated physical activity intensity (MET ranges), targeted body regions (upper extremity, lower extremity, trunk, or whole body), age suitability, and environmental requirements. These structured data are being used to build a preliminary game database. Based on this database, an artificial intelligence–assisted recommendation algorithm is being developed to generate game suggestions according to user-defined parameters such as desired activity intensity and target body region. A prototype mobile application interface is currently under development to integrate the game database and recommendation.

Results: The prototype system is expected to generate tailored game recommendations that align with specified physical activity intensity levels and target body segments. This approach may support structured physical activity planning using culturally relevant traditional games.

Conclusions: The proposed mobile application aims to provide an innovative and accessible tool for promoting physical activity in children. Once completed, the system may assist physiotherapists, educators, and parents in selecting appropriate games that target specific physical activity goals.

Keywords: Artificial Intelligence, Mobile Applications, Motor Activity, Play and Playthings, Child

DEVELOPMENT OF A SMART INSOLE-BASED PROTOTYPE FOR MONITORING PARTIAL WEIGHT BEARING AND SYMMETRICAL LOADING IN LOWER EXTREMITY REHABILITATION

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Abstract

Purpose: The aim of this study was to develop a smart insole-based system capable of monitoring plantar loading in individuals undergoing lower extremity rehabilitation after knee or hip surgery and to perform a preliminary pilot evaluation of the prototype.

Methods: A prototype smart insole system was developed using plantar pressure sensors positioned under key plantar regions including the heel and forefoot. Sensor signals were processed through a microcontroller-based data acquisition unit and transmitted to a monitoring interface capable of providing real-time feedback. The system was designed to operate in two modes: a partial weight-bearing monitoring mode and a symmetrical loading monitoring mode. Following prototype development, preliminary testing was conducted with a small group of volunteers to evaluate the functionality of the system during standing and walking tasks. The prototype provided visual feedback when loading exceeded or fell below predefined thresholds.

Results: Initial pilot testing demonstrated that the prototype system was able to detect plantar loading changes and identify deviations from the target loading range during functional tasks. The system successfully monitored weight distribution and provided real-time feedback during simulated partial weight-bearing and symmetrical loading conditions.

Conclusions: The developed smart insole system shows potential as a portable tool for monitoring loading patterns during rehabilitation. The prototype may support physiotherapists in guiding weight-bearing training and may contribute to improving loading control in patients undergoing lower extremity rehabilitation.

Keywords: Physical Therapy Modalities, Weight-Bearing, Insoles, Pressure, Rehabilitation

EFFECT OF A MOBILE APPLICATION–SUPPORTED HOME EXERCISE PROGRAM ON POSTURE, BALANCE, PAIN AND FUNCTIONALITY IN INDIVIDUALS WITH MECHANICAL LOW BACK PAIN

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Abstract

Purpose: The aim of this study is to investigate the effects of a mobile application–supported home exercise program on posture, balance, pain, and functional status in individuals with mechanical low back pain.

Methods: This randomized controlled study is conducted at the Karabük University Physiotherapy and Rehabilitation Research and Application Center. Fifty individuals aged 18–65 years with chronic mechanical low back pain are planned to be included and randomly assigned to two groups. Both groups will perform the same home exercise program three times per week for six weeks. The control group will receive printed exercise instructions, whereas the experimental group will perform the exercises using the E-Exercise mobile application, which includes video demonstrations and reminder notifications. Outcomes include flexibility tests, posture analysis using PostureScreenLite, postural balance assessed with the Bertec Balance System, pain intensity measured with the Visual Analog Scale, functional disability evaluated by the Oswestry Disability Index, and quality of life assessed with the SF-12 questionnaire.

Results: The study is ongoing and the mobile application is in the pilot phase. Preliminary observations suggest increased motivation and improved adherence among participants using the application. Early evaluations also indicate reductions in pain and improvements in functional disability and flexibility.

Conclusions: Mobile application–supported home exercise programs may enhance adherence and improve rehabilitation outcomes in individuals with mechanical low back pain.

Keywords: Low Back Pain, Exercise Therapy, Mobile Applications, Posture, Rehabilitation

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TECHNOLOGY-SUPPORTED AND TRADITIONAL EXERCISE GAMES IN INCLUSIVE PEDIATRIC REHABILITATION

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Abstract

Purpose: This study aimed to investigate the effects of a mixed activity program including technology-supported exercise games and traditional physical games on physical activity participation, postural control, balance, and social interaction in children with and without special needs.

Methods: This study included 40 children aged 6–14 years: 20 children with special needs and 20 typically developing peers. Participants attended structured group activity sessions designed by physiotherapists and educators. The program consisted of video-guided exercise games, simple robotic coding–based play activities, and traditional movement-based games aimed at improving coordination, physical activity participation, and peer interaction. Postural alignment was assessed using the PostureScreenLite mobile application, while balance performance was evaluated using the Bertec Balance System. Physical activity levels were measured using a validated physical activity questionnaire. Social behavior, empathy, and cognitive awareness were assessed using standardized child evaluation scales.

Results: After the intervention period, improvements were observed in postural alignment and balance parameters in children with special needs ($p<0.05$). Physical activity participation scores significantly increased in both groups ($p=0.018$). Balance performance showed moderate improvement following the activity program ($p=0.031$). In addition, physical activity participation was positively correlated with social interaction scores ($r=0.42$, $p=0.007$). Empathy scores of typically developing children also showed improvement after inclusive activity sessions ($p=0.024$).

Conclusions: A program combining technology-supported exercise games and traditional physical games may provide an effective and engaging approach for inclusive pediatric rehabilitation by supporting both motor and psychosocial development. This study was supported by the TUBITAK 2209 Program.

Keywords: Child, Motor Activity, Play and Playthings, Rehabilitation

DETERMINING AN OPTIMAL MSSQ CUT-OFF FOR PREDICTING VR-INDUCED CYBERSICKNESS: A ROC ANALYSIS

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Abstract

Purpose: Cybersickness is a major limitation to the safe implementation of virtual reality (VR). Individual susceptibility varies, and the Motion Sickness Susceptibility Questionnaire–Short Form (MSSQ-Short) is commonly used to estimate this risk. Therefore, this study aimed to determine a potential MSSQ-Short cut-off for predicting VR-induced cybersickness.

Methods: Participants were assessed for motion sickness susceptibility using the MSSQ-Short prior to VR exposure. A 10-minute roller coaster simulation was used to induce cybersickness in a VR environment. Cybersickness symptoms were evaluated immediately after exposure using the Simulator Sickness Questionnaire (SSQ). SSQ total scores were used to classify participants based on the presence of cybersickness symptoms.

Results: A total of 30 participants were included in the analysis. Receiver operating characteristic (ROC) analysis showed acceptable discrimination of MSSQ, with an area under the curve (AUC) of 0.797 (95% CI: 0.637–0.956, p = 0.006). Based on the observed balance between sensitivity and specificity, a cut-off score of 15 was selected. At this threshold, MSSQ showed a sensitivity of 75.0% and a specificity of 64.3%, indicating a moderate ability to identify individuals at risk of cybersickness.

Conclusions: An MSSQ-Short cut-off of 15 may provide a practical balance between sensitivity and specificity for identifying individuals at risk of VR-induced cybersickness. However, the use of a highly provocative VR stimulus may have influenced symptom expression and limits the generalizability of these findings to less demanding VR applications. Further studies using different types of VR content are needed to establish more generalizable thresholds.

Keywords: Virtual reality, Cybersickness, Motion Sickness

INVESTIGATION OF THE ACUTE EFFECTS OF WEARABLE ELECTRICAL STIMULATION ON SPASTICITY, UPPER AND LOWER EXTREMITY FUNCTIONS, AND GAIT IN PATIENTS WITH STROKE

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Abstract

Purpose: The aim of our study was to clinically evaluate the acute effects of the EXOPULSE Mollii Suit wearable electrical stimulation application on spasticity severity, pain, fatigue, upper and lower limb function, balance, gait, endurance, and hand function in stroke patients.

Methods: In the study, 27 individuals diagnosed with stroke were randomly assigned to either the treatment group (n=15, age: 57.00 ± 6.24 years) or the control group (n=12, age: 57.08 ± 14.06 years). The severity of spasticity in the participants' upper and lower limb muscles was assessed using the Modified Ashworth Scale (MAS). The results were recorded in the Mollii Suit system's computer interface. Subsequently, the participants were fitted with the Mollii Suit system's garments. The Mollii group received electrical stimulation at the intensity prescribed by the system via the wearable garment for 1 hour (using 56 embedded silicone electrodes within the garment). The control group was fitted with the EXOPULSE Mollii system garments, and only the neck and unaffected extremities received electrical stimulation at the minimum intensity for 1 hour. Assessments were conducted twice by a blinded researcher: immediately before wearing the Mollii Suit garment and immediately after the application. Participants' pain, fatigue, and satisfaction levels were assessed using the Visual Analog Scale (VAS); hand performance via the 9-Hole Peg Test; functional capacity via the STREAM Scale; and lower extremity functional level via the 5-Times Sit-Stand Test, functional mobility skills via the Timed Stand and Walk Test, and walking performance via the 10-Meter Walk Test.

Results: Analysis of the study results revealed a reduction in the severity of spasticity in the finger flexor and plantar flexor muscles in the Mollii group ($p<0.05$). A significant improvement within the Mollii group was observed on the STREAM scale. Improvement was observed in both groups in the Five-Repetition Sit-to-Stand Test ($p<0.05$). In the 10-Meter Walk Test, a significant within-group improvement was detected in the Mollii group, while in the Timed Sit-to-Stand and Walk Test, a significant within-group improvement was found in the control group ($p<0.05$). In the assessment of study satisfaction, a statistically significant difference was found in favor of the Mollii group ($p<0.05$). In the measurements of pain, fatigue, and upper extremity performance, no statistically significant differences were found within or between the two groups ($p>0.05$).

Conclusions: The Exopulse Mollii Suit wearable electrical stimulation system was found to have acute positive effects on spasticity, functional capacity, and gait performance; however, it was found to have no significant acute effect on pain, fatigue, upper extremity function, or overall lower extremity performance between groups. These results suggest that the EXOPULSE Mollii Suit shows promising outcomes as a complementary intervention in stroke rehabilitation; however, they also indicate that more comprehensive studies are needed to evaluate its efficacy across broader patient populations, functional outcomes, and long-term effects.

Keywords: Stroke, Spasticity, Wearable Electrical Stimulation, EXOPULSE Mollii Suit, Hemiplegia

EFFECTS OF TRIGGER POINT PRESSURE AND MANUAL THERAPY APPLICATIONS ON NECK AND BACK PAIN IN DESK WORKERS

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Abstract

Purpose: This study aimed to investigate the effects of an intervention program on pain intensity, functional status, and quality of life in individuals with trigger points in the neck and upper back region.

Methods: A total of 39 volunteers participated in the study and were divided into a control group (n=19) and an intervention group (n=20). The control group received standard posture exercises and ergonomics training, while the intervention group received these in addition to manual therapy and ischemic compressions at trigger points in the neck and upper back region. Demographic characteristics such as age, height, weight, body mass index (BMI), and working years were recorded. Pain intensity was assessed using the Visual Analog Scale (VAS) at rest and during activity. Functional disability was evaluated with the Neck Disability Index (NDI), and quality of life was measured using the Short Form-12 Health Survey (SF-12).

Results: According to the results of the study, significant improvements were observed in pain, neck disability, and the physical components of the Short Form-12 Health Survey (SF-12) in both groups. ($p<0.05$). However, no significant differences were found between the groups. ($p>0.05$).

Conclusions: The results suggest that the intervention program may be an effective approach for reducing pain and improving functional status and quality of life in individuals with trigger points.

Keywords: Trigger Point, Pain, Physiotherapy, Functional Status, Quality of Life

DEVELOPMENT OF A DUAL TASK ASSESSMENT AND REHABILITATION SYSTEM AND INVESTIGATION OF ITS EFFECTIVENESS IN PARKINSON'S DISEASE PATIENTS

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Abstract

Purpose: Dual-task activities in Parkinson's disease are impaired by motor and cognitive deficits. Existing objective technologies evaluate cognitive-motor performance but largely neglect motor-motor coordination. Thus, integrated systems assessing both motor-cognitive and motor-motor dual-task performance combining upper and lower extremities are lacking.

Methods: The proposed "DualFlow" system incorporates an interactive floor, touch-screen dashboards, and assessment software. Individuals perform lower extremity weight transfer tasks while using their upper extremities to touch panel positions in response to visual and auditory stimuli. For cognitive-motor tasks, mathematical operations are displayed, requiring participants to touch the correct answers. The system will undergo a three-stage clinical evaluation: assessing feasibility, establishing validity and reliability, and determining clinical effectiveness on dual-task performance via a randomized controlled trial.

Results: DualFlow is designed to enable controlled testing and rehabilitation for motor-motor and motor-cognitive dual tasks. By engaging the upper extremities through external stimuli alongside lower-extremity tasks, the intervention aims to minimize PD symptoms such as bradykinesia and freezing. The project aims to provide objective measurements while assessing the system's validity and reliability.

Conclusions: By integrating upper and lower extremities, the DualFlow system facilitates comprehensive dual-task evaluation and rehabilitation. Ultimately, this approach seeks to improve dual-task coordination during activities of daily living. Thus, the system may help reduce the risk of falls and support greater independence and quality of life for individuals with PD.

Keywords: Assessment, Dual task, Parkinson's Disease, Rehabilitation

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A NEW PORTABLE PRESSURE MAPPING SYSTEM: DEVELOPMENT AND VALIDATION USING STANDARD WEIGHTS

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Abstract

Purpose: The aim of this study is to develop a pressure mapping system that is locally made, low-cost, portable, devoid of ionizing radiation, and can provide digital and visual output to evaluate pressure distribution while sitting**.**

Methods: The prototype was created by integrating a flexible sensor panel having piezoresistive capabilities into an Arduino-based microcontroller. Data from the sensors was sent to a computer via USB connection and viewed using specific software written in Python, Java, and HTML. The device is designed to measure static sitting pressure in seconds and display the data as a color-coded pressure map that can be downloaded to PDF. The application is designed to work on both Windows and iOS-based systems. The prototype's performance and the software's accuracy were evaluated using standard weights in three distinct combinations, with ten repetitions for each combination, and the standard deviations of the collected data were determined.

Results: The prototype accurately measured pressure distribution in a sitting position. The pressure distribution in the center, right-left, and top-bottom zones was computed as a percentage based on multiple measurements, and the greatest standard deviation of the acquired data was 1.69%.

Conclusions: A low-cost, portable, non-invasive "Pressure Mapping System Prototype" was developed to measure pressure distribution in sitting positions. The prototype quickly and reliably calculates pressure distribution percentages based on repeated measurements with weights placed in various areas, demonstrating high measurement reliability due to a low standard deviation rate in the data. Future studies should investigate the validity and reliability of the prototype in different disease groups.

Keywords: pressure, posture, Sitting Position, Equipment design

MAPPING THE SCIENTIFIC LANDSCAPE OF EXERGAMES RESEARCH IN DEMENTIA: A BIBLIOMETRIC ANALYSIS OF GLOBAL PUBLICATIONS

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Abstract

Purpose: The aim of this study is to provide an in-depth analysis of the research landscape regarding dementia and exergames within global research.

Methods: Within the scope of this study, research articles related to dementia and exergames published in English in the Web of Science database up to March 11, 2026 were examined using bibliometric analysis. Relevant publications were obtained using keywords such as “dementia,” “Alzheimer's disease,” “mild cognitive impairment,” and “exergame”, “exercise game” or “active video games”. The VOSviewer program was used for data visualization and network mapping.

Results: A total of 352 relevant articles published between 2008 and 2026 were obtained. The analysis revealed that there has been a significant increase in studies on the use of exergames in dementia since 2014, with the highest number of publications occurring in 2025 (14.5%). The findings indicate that the United States (15.05%), China (11.36%), and Canada (11.08%) are the countries that contribute the most in terms of publication volume in this field. In terms of author contributions, De Bruin ED (5.11%), Tsolaki M (4.26%), Manera V (3.40%), and Robert P (3.40%) were the most active researchers. Additionally, the most frequently used keywords in these publications include "mild cognitive impairment", "Alzheimer's disease", "dementia", "serious games", and "virtual reality".

Conclusions: This research may guide future study by presenting an overview and indicating future trends of global publication findings in the field of dementia exergames.

Keywords: Alzheimer Disease, Bibliometrics, Dementia, Exergaming, Virtual Reality

A CROSS-SECTIONAL ANALYSIS OF BODY BALANCE AND FALL RISK PARAMETERS BEFORE AND AFTER TOTAL KNEE ARTHROPLASTY SURGERY

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Abstract

Purpose: Gait-related biomechanical alterations are common in knee osteoarthritis (OA) and may persist or evolve after total knee arthroplasty (TKA). Identifying gait parameters linked to functional decline and fall risk is clinically important. The objective of the study was to investigate the associations between gait kinetics/kinematics, functional outcomes, and fall risk across OA stages and in patients TKA.

Methods: A total of 105 patients aged ≥55 years with primary knee OA were stratified by Kellgren–Lawrence (KL) grade: Group 1 (KL 1–2), Group 2 (KL 3–4), and Group 3 (TKA). Functional status and quality of life were assessed using the WOMAC. Muscle strength, balance, and spatiotemporal, kinetic, and kinematic gait parameters were evaluated via computerized gait analysis and stabilometry. Fall risk was assessed using the Timed Up and Go (TUG) test and biomechanical measures.

Results: Muscle strength and static balance were reduced in Groups 2 and 3. Ground reaction force (GRF) and knee angular measures were higher in Group 1, whereas step duration and knee flexion angles were greater in Group 3 ($p<0.05$). TUG performance correlated significantly with age, BMI, hip abduction strength, center of pressure displacement, knee flexion, stance-phase joint moments, walking speed, and step duration ($p<0.05$). Increased fall risk was associated with reduced bilateral lower-limb strength, lower GRF peaks, limited knee ROM, slower gait, and shorter step length; female sex was also a risk factor.

Conclusions: Particularly prolonged TUG (>12 s), strength asymmetry, reduced GRF, and altered stance-phase moments—are key indicators of fall risk in advanced OA and post-TKA. Incorporating fall risk into TKA decision-making and targeted rehabilitation may reduce fractures and healthcare burden.

Keywords: Knee Osteoarthritis, Arthroplasty, Falls, Gait Analysis, Balance

VALIDITY AND RELIABILITY OF THE TURKISH VERSION OF THE USEFULNESS, SATISFACTION, AND EASE OF USE QUESTIONNAIRE (USE) IN NEUROLOGICAL PATIENTS

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Abstract

Purpose: To examine the validity and reliability of the Turkish version of the Usefulness, Satisfaction, and Ease of Use Questionnaire (USE).

Methods: A total of 171 neurological patients (mean age: 45.72 ± 17.24 years; 64 females, 107 males) who had received at least five sessions of robotic rehabilitation were included in the study. Test–retest reliability was assessed to evaluate the reliability of the USE questionnaire. Construct validity was examined using confirmatory factor analysis (CFA), and internal consistency was evaluated using Cronbach's alpha coefficient. Criterion validity was assessed using the System Usability Scale (SUS), while convergent validity was evaluated with the Intrinsic Motivation Inventory (IMI), Beck Depression Inventory (BDI), and the World Health Organization Quality of Life Scale–Brief Form (WHOQOL-BREF).

Results: The USE questionnaire was found to consist of four subscales. It demonstrated high internal consistency (Cronbach's alpha = 0.977) and excellent test–retest reliability (ICC = 0.987). A positive and statistically significant correlation was observed between USE and SUS ($p < 0.05$). USE showed a moderate positive correlation with IMI ($r = 0.472$), a very weak positive correlation with WHOQOL-BREF ($r = 0.183$), and a very weak negative correlation with BDI ($r = -0.185$).

Conclusions: The Turkish version of the USE questionnaire is a valid and reliable instrument for assessing usefulness, satisfaction, and ease of use in neurological patients undergoing robotic rehabilitation.

Keywords: Validity, Reliability, Satisfaction, User Experience

COMPARISON OF THE ACUTE PHYSIOLOGICAL AND METABOLIC EFFECTS OF REAL WALKING AND VIRTUAL REALITY-BASED WALKING SIMULATION ON LOWER EXTREMITY MUSCLES IN HEALTHY INDIVIDUALS

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Abstract

Purpose: This study aims to comparatively examine the acute physiological and metabolic effects of a virtual reality (VR)-based walking simulation versus actual walking (6-Minute Walk Test; 6MWT) on the primary lower extremity locomotor muscles, Vastus Lateralis (VL) and Gastrocnemius (GC), in healthy individuals.

Methods: Thirty healthy volunteers (aged 18–30, BMI ≤ 30 kg/m²) were included. Participants first performed the 6MWT followed by a 2-minute seated rest. In the VR protocol, seated participants watched a 6-minute 360° walking video via 'Oculus Quest 3' goggles. Muscle oxygenation (SmO_2, HBDiff, tHb) was recorded simultaneously from the dominant VL and GC using TrainRED NIRS devices during both protocols.

Results: Significant pre-to-post 6MWT HBDiff changes were statistically found in the GC (p=0.004) and VL (p=0.001). For the VR protocol, significant pre-to-post changes were observed in HBDiff (GC: p<0.001; VL: p=0.001). When comparing the physiological shifts between 6MWT and VR protocols, no significant differences were observed for the GC (SmO_2 p=0.131; HBDiff p=0.147; THB p=0.339) or the VL (SmO_2 p=0.271; HBDiff p=0.066; THB p=0.658).

Conclusions: The findings of this study indicate that virtual reality-based gait simulation can elicit acute physiological responses in muscle oxygenation and blood volume parameters in lower extremity muscles similar to actual walking. Therefore, it is considered that virtual reality applications may be an alternative approach with the potential to stimulate muscle metabolism and support rehabilitation processes, especially in cases where physical activity is limited.

Keywords: Virtual Reality, Gait, Gastrocnemius, Vastus Lateralis, Muscle Oxygenation

INVESTIGATION OF THE EFFECTS OF GAME SUPPORTED REHABILITATION PROGRAM IN SCA 48 PATIENT WITH CO-OCCURRENCE OF ATAXIA AND PARKINSON'S DISEASE: A CASE REPORT

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Abstract

Purpose: This case report aims to examine the effects of a personalized rehabilitation program combining routine physiotherapy with a virtual reality game (Upper Extremity Smart Exercises Innovative Treatment - USE-IT) on balance, trunk performance, fall risk, gait, fatigue, and Parkinson's symptoms in a Spinocerebellar Ataxia 48 (SCA48) patient presenting with co-occurring Ataxia and Parkinsonism.

Methods: A 65-year-old female with a genetic diagnosis was included. The patient was followed for 18 weeks, with one clinical session per week (45 min traditional physiotherapy + 15 min USE-IT play therapy) and a home program on the other days. Assessments conducted pre- and post-treatment included the Berg Balance Scale (BBS) for functional balance; Trunk Impairment Scale (TIS) to evaluate static/dynamic sitting balance and coordination; Timed Up and Go (TUG) for dynamic balance and fall risk; 10-Meter Walk Test (10mWT) for gait speed; Fatigue Severity Scale (FSS) for subjective fatigue; and the Unified Parkinson's Disease Rating Scale (UPDRS) to assess the severity of Parkinsonian motor and non-motor symptoms.

Results: Post-treatment, BBS scores improved from 48 to 55 and TIS from 13 to 15. The 10mWT duration decreased from 7.93 to 6.16 seconds, and TUG from 11.20 to 8.43 seconds. Clinical improvements were noted in gait fluidity and turning.

Conclusions: The results suggest that virtual reality gaming, which simultaneously targets motor and cognitive domains, may be an effective option for rehabilitation in complex charts such as SCA48, by improving dynamic/static balance, increasing walking speed, and reducing the risk of falls.

Keywords: SCA48, Ataxia, Parkinsonism, Neurological Rehabilitation, Exergame

THE EFFECT OF MODIFIED-LSVT BIG TRAINING ON COGNITIVE STATUS, PHYSICAL PERFORMANCE, AND PROPRIOCEPTION IN INDIVIDUALS WITH MULTIPLE SCLEROSIS: A PILOT STUDY

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Abstract

Purpose: This study aimed to investigate the effectiveness of modified-LSVT BIG (m-LSVT BIG) training on fatigue, physical performance, and proprioception in individuals diagnosed with Multiple Sclerosis (MS).

Methods: Two individuals diagnosed with MS (EDSS; P1:2,5, P2:2,5) were included in the study. Neither participant had previously received m-LSVT BIG treatment. Pre-treatment fatigue was measured using the Fatigue Severity Scale (FSS). Balance was evaluated using the Berg Balance Scale (BBS). Muscle strength with a hand dynamometer. Physical performance was measured using the L-Test and the Timed 25-Foot Walk (T25-FW). Finally, proprioception was measured with a dual inclinometer. Each test was repeated after 3 weeks of treatment.

Results: P1 was a 45-year-old female patient, and P2 was a 35-year-old female patient. Patients showed improvements in FSS (P1: from 54 to 53, P2: from 60 to 55), BBS (P1: from 40 to 48, P2: from 50 to 51), muscle strength (P1: from 8,96 to 10, P2: from 18,3 to 19,60 and P1: from 8,76 to 9,86, P2: from 13,33 to 13,66, hip flexion, kNee flexion, respectively), L-test (P1: from 15,34 to 13,75, P2: from 14,13 to 12,31), T25-FW (P1: from 6,37s to 5,21s, P2: from 5,42 to 4,50), and proprioceptive sense (P1: from 11 to 3, P2: from 4 to 1, degree, dominant extremity).

Conclusions: m-LSVT BIG treatment may reduce fatigue as well as impairments in balance, muscle strength, mobility, and proprioceptive sensitivity in individuals with MS.

Keywords: Multiple Sclerosis, Rehabilitation, Fatigue, Physical Performance, Proprioception

METHODOLOGICAL DIFFERENCES IN ROBOTIC INTERVENTIONS AND THE EFFECT OF TREATMENT DOSE ON UPPER EXTREMITY REHABILITATION AFTER STROKE: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Abstract

Purpose: Post-stroke robot-assisted therapy (RAT) studies show methodological heterogeneity in intervention protocols. However, optimal dose for upper extremity (UE) motor recovery remains unclear, particularly regarding treatment duration and combination. This study aimed to examine methodological differences in robotic applications used in post-stroke UE rehabilitation, compare RAT and RAT+conventional treatment (RAT+CT), and determine treatment duration associated with improved UE motor performance.

Methods: PubMed, Embase, Cochrane Library, Scopus, Web of Science, and ScienceDirect were independently searched from 2000 to 2025. A total of 2.640 studies were evaluated; 25 randomized controlled trials meeting the inclusion criteria were included in the meta-analysis. Common outcome measure across all studies was Fugl-Meyer Assessment for UE (FMA-UE). The analysis included a total of 1.184 patients diagnosed with stroke.

Results: In the meta-analysis, robotic rehabilitation had a significant small-to-moderate effect on UE motor function (SMD=0.305; 95%CI: 0.153–0.456; $p<0.001$). In the subgroup analysis, RAT+CT yielded significant improvement (SMD=0.380; 95%CI: 0.148–0.613; $p=0.003$), whereas the effect in RAT group remained borderline ($p=0.051$). However, the between-group difference wasn't significant ($p=0.303$). In the analysis of total treatment duration for RAT+CT, durations of 10–15 hours and 15–20 hours were associated with significant improvement; no additional superiority was demonstrated at longer durations.

Conclusions: Robotic rehabilitation studies show methodological diversity across many treatment components. Although the current evidence suggests that RAT+CT provides more clinically consistent outcomes, no clear superiority over RAT has been demonstrated. For RAT+CT, a total treatment duration of 10–20 hours appears to be the most appropriate range for improvement in FMA-UE.

Keywords: Stroke, Robotics, Rehabilitation, Upper Extremity, Treatment Outcome

INVESTIGATION OF PHYSIOTHERAPY AND REHABILITATION STUDENTS' PERSPECTIVES, ACCEPTANCE, AND LITERACY LEVELS REGARDING ARTIFICIAL INTELLIGENCE

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Abstract

Purpose: With technology integrating into daily life, Artificial Intelligence (AI) has become a crucial component of information technologies, influencing healthcare disciplines like physiotherapy and rehabilitation. This study aimed to determine the perspectives, acceptance, and literacy levels of physiotherapy and rehabilitation students regarding AI.

Methods: The study included 119 physiotherapy and rehabilitation students (21.78±1.76 years) from three universities. Students' AI perspectives were assessed with open-ended questions. AI acceptance was evaluated using the Artificial Intelligence Acceptance Scale Short Form, and AI literacy was measured with the Artificial Intelligence Literacy Scale (AILS).

Results: It was determined that 98.3% of students used AI tools such as Gemini/ChatGPT for homework and research. The rate of those receiving AI training was 11.8%. The majority indicated that "access to information from anywhere" (63%) was the most significant advantage of AI, while "the possibility of information being unreliable" (69.7%) was its main disadvantage. Students' AI acceptance (20.10±3.17) and AI literacy levels (59.79±8.69) did not differ significantly based on grade point average, class, or duration of technology use ($p>0.05$).

Conclusions: Our study demonstrates that physiotherapy and rehabilitation students recognize the potential of AI, with high levels of AI acceptance and literacy. However, most students have not received formal AI education, and uncertainty remains about whether they use AI efficiently. Curriculum regulations related to AI could enhance the efficient and accurate use of AI among students, contributing to the training of contemporary physiotherapists.

Keywords: Artificial Intelligence, Literacy, Physiotherapy, Students

THE RELATIONSHIP BETWEEN TECHNOLOGY USE, MENTAL FATIGUE, COGNITIVE STATUS, AND SLEEP QUALITY AMONG UNIVERSITY STUDENTS

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Abstract

Purpose: With the widespread use of technological devices nowadays, the increased time spent in front of screens can affect mental fatigue, cognitive function, and sleep. This study aimed to investigate the relations of technology use to mental fatigue, cognitive functioning, and sleep quality in university students.

Methods: This cross-sectional study included a total of 40 voluntarily university students (20 women, 20 men) aged 18-25 years (20.92±1.63 years). The data was collected using Multiple Screen Addiction Scale (MSAS), Mental Fatigue Scale (MFS), The Cognitive Failures Questionnaire (CFQ), and The Pittsburgh Sleep Quality Index (PSQI).

Results: Students reported using Instagram and Facebook on social media, spending an average of 4.88±3.22 hours on these platforms. According to the MSAS, 65% (n=26) of the students were identified with screen addiction, while 87.5% (n=35) were found to have poor sleep quality based on the PSQI. Screen time was correlated with MSAS scores ($r=0.704$, $p<0.05$) and subjective sleep quality ($r=-0.315$, $p<0.05$). Additionally, positive correlations were detected between CFQ and MFS ($r=0.491$, $p<0.05$), social media time ($r=0.317$, $p<0.05$), daytime dysfunction ($r=0.477$, $p<0.05$), and PSQI total score ($r=0.466$,$p<0.05$).

Conclusions: Our study revealed that screen addiction and poor sleep quality are common among university students; increased screen and social media use impairs sleep quality, while impaired cognitive function further exacerbates mental fatigue. Raising awareness about screen and social media use among university students and regulating usage times can positively impact sleep quality and cognitive status directly, and mental fatigue levels indirectly.

Keywords: Cognition, Mental Fatigue, Sleep, Students, Technology

CLINICAL FEASIBILITY AND USABILITY OF AN EXERGAMING SYSTEM: A PILOT STUDY WITH PHYSIOTHERAPISTS

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Abstract

Purpose: This study aimed to evaluate the usability, user satisfaction, clinical feasibility, and acceptability of an exergaming system developed by the researchers.

Methods:Thirteen physiotherapists with at least one year of clinical experience and active clinical practice were included. After an explanation of the study procedures, the system was introduced and demonstrated by the researchers. Each physiotherapist then conducted a single-session application with a willing participant who had prior experience with the exergame system. Usability was assessed using the System Usability Scale (SUS, 10–50 points). User satisfaction was evaluated with the User Satisfaction Evaluation Questionnaire (USEQ, 6–30 points). Clinical feasibility and acceptability were assessed using the Feasibility of Intervention Measure (FIM, 4–20 points) and the Acceptability of Intervention Measure (AIM, 4–20 points).

Results: Of the thirteen physiotherapists, seven worked in orthopedic rehabilitation. The overall mean age was 28 years, and the mean professional experience was 7 years. Participants demonstrated very high scores on the SUS (47.3/50), USEQ (28.7/30), FIM (19.1/20), and AIM (18.6/20). They identified key strengths as the adaptable game scenario accommodating different acceleration and deceleration phases, heart rate monitoring, and speed-adaptive avatars. Three participants suggested that voice integration would further enrich the system.

Conclusions: The exergame system was found to be usable, feasible, and acceptable in clinical settings, with high physiotherapist satisfaction. Future studies should evaluate its applicability in diverse clinical populations.

Keywords: Exergame, Physiotherapists, Clinical Feasibility, User Satisfaction

MAPPING AMBULATION-STAGE TECHNOLOGIES BY FUNCTIONAL AMBULATION CATEGORIES (FAC): A ÜTS-BASED GAP ANALYSIS TO PRIORITIZE R&D AND DOMESTIC MANUFACTURING IN TÜRKİYE

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Abstract

Purpose: To identify domestically produced technologies used in neurological rehabilitation in Türkiye by extracting Product Tracking System (ÜTS) records (February 2026), mapping them to Functional Ambulation Categories (FAC 0–5), and identifying missing categories to prioritize research and development and manufacturing.

Methods: Ambulation stages were defined using FAC (0: non-ambulatory/≥2-person assist; 1: continuous 1-person support; 2: intermittent/light-touch 1-person support; 3: supervision/stand-by; 4: independent on level surfaces; 5: independent everywhere). Study-defined Ambulation Activity Categories (AAC) were operationalized, anchored to FAC: AAC0 verticalization/in-bed preparation training; AAC1 first-step initiation/assisted gait training; AAC2 supported standing/weight shift/early dynamic balance training; AAC3 supervised overground walking training (turning, starts/stops, basic obstacles); AAC4 independent walking/advanced task training; AAC5 dynamic/reactive balance and fall-prevention training. Technologies were mapped “sliding” across adjacent FAC levels: Category0 in-bed/tilt-table–combined systems (FAC0); Category1 tethered robotics (FAC1–2); Category2 supported static/dynamic balance systems (FAC1–2); Category3 untethered robotics (FAC2–3); Category4 BWSTT (FAC3–4); Category5 dynamic/reactive balance systems (FAC4–5). ÜTS was searched using Branch Type filters (Robotik rehabilitasyon/Robotik olmayan rehabilitasyon/Denge/Dik durma sehpası) and Country of Origin: Türkiye; eligible records were categorized, and active or semi-active devices with electronic features were noted.

Results: N=82 records were retrieved; n=4 eligible products were identified: RoboGait (Category1), SBT–Standing Balance Trainer (Category2), FreeGait (Category3), and Fizyowalk-1000 Basic (Category4). No eligible Türkiye-origin products were identified for Category0 or Category5, indicating gaps at the FAC0–1 and FAC4–5.

Conclusions: A FAC-anchored ÜTS mapping highlights stage-specific gaps; top priority is domestic development of in-bed/tilt-table–combined systems, with an additional gap in dynamic/reactive balance systems.

Keywords: Robotics, Rehabilitation, Postural Balance, Gait

PHYSIOLOGICAL STRESS RESPONSES TO DIFFERENT EXERCISE MODALITIES IN INDIVIDUALS WITH MULTIPLE SCLEROSIS

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Abstract

Purpose: The aim of this study was to examine acute physiological stress responses to physiotherapy-based exercises in individuals with Multiple Sclerosis using galvanic skin response measurements.

Methods: Physiological stress responses were evaluated using galvanic skin response (GSR) recorded with the wearable Shimmer GSR+ 3 sensor (Shimmer Research, Dublin, Ireland) before, during, and immediately after exercise. Participants performed two exercise modalities: aerobic exercise on a cycle ergometer at 65% VO_2max (Karvonen method) and physiotherapy exercises including balance and strengthening at moderate intensity (modified Borg scale). Stress responses between the two exercise conditions were compared in individuals with Multiple Sclerosis.

Results: Paired samples t-test showed a significant increase in galvanic skin response (GSR) after both aerobic exercise ($t(12) = -10.93$, $p < 0.001$) and physiotherapy exercises ($t(12) = -3.04$, $p = 0.010$) in individuals with Multiple Sclerosis. No significant difference in ΔGSR was found between the two exercise modalities ($t(12) = 1.42$, $p = 0.184$), suggesting that both exercises elicited comparable sympathetic nervous system activation.

Conclusions: Both aerobic and physiotherapy exercises elicited significant but moderate increases in galvanic skin response, indicating safe activation of the sympathetic nervous system in individuals with Multiple Sclerosis. No significant difference was observed between the two exercise modalities, suggesting that both can be applied safely in clinical rehabilitation settings. These findings support the inclusion of balance, strengthening, and aerobic exercises in individualized MS exercise programs without concern for excessive autonomic stress.

Keywords: Multiple Sclerosis, Exercise, Physiological Stress, Galvanic Skin Response

ASSOCIATION OF LOWER LIMB AND TRUNK ISOMETRIC STRENGTH WITH AGILITY PERFORMANCE IN SOCCER PLAYERS

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Abstract

Purpose: Soccer players often accelerate, decelerate, and change direction quickly during training and matches. The purpose of this study was to evaluate the relationship between the isometric strength of the lower limb and trunk and agility performance in soccer players.

Methods: The study included 20 healthy male soccer players (age: 18.41±1.02 years; body height: 176.55±7.66 cm; body weight: 70.72±7.60 kg). Isometric muscle strength was assessed using the DIERS Myoline System (DIERS International GmbH, Schlangenbad, Germany). Lower limb abduction and adduction strength were evaluated bilaterally. Additionally, trunk strength was evaluated through flexion, extension, and bilateral lateral flexion measurements. The Speedcourt measurement system (Globalspeed GmbH, Hemsbach, Germany) was used for the agility assessment. The assessment included total task duration, mean contact time for the dominant and non-dominant sides. It also included the percentage of inter-limb asymmetry. Statistical analyses were conducted using IBM SPSS Statistics (version 27.0). Pearson and Spearman correlation coefficients were employed to evaluate the strength and direction of the associations between the variables.

Results: There was no significant correlation between athletes' lower-limb and trunk isometric strength and their agility performance ($p>0.05$).

Conclusions: This preliminary study revealed that lower limb and trunk isometric strength is not associated with agility performance. This may be due to the dynamic nature of agility performance. It may also be a consequence of agility relying on multiple components such as reaction time, change of direction technique, neuromuscular control, balance, and decision-making.

Keywords: Athletic Performance, Isometric Contraction, Lower Extremity, Muscle Strength, Physical Fitness

DEVELOPMENT OF A SIGN LANGUAGE–SUPPORTED MOBILE EXERCISE APPLICATION: IDEA

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Abstract

Purpose: Individuals with hearing impairment experience various difficulties in accessing exercise education, including communication barriers, difficulty following verbal instructions, and limited access to appropriate educational materials. This study aimed to develop accessible mobile application compatible with digital health approaches as alternative to traditional educational materials for this population.

Methods: The application was developed based on the Angular Framework following professional UI/UX design process. TypeScript, HTML, and CSS technologies were used during development, and compatibility with both Android and iOS platforms was achieved through the Capacitor infrastructure. Data management was carried out using Firebase Firestore, while video content was stored in cloud-based storage system.

Results: After registration, users encounter an exercise safety information screen. Exercises classified by the research team according to age and difficulty level are assigned based on the user's preference for equipment-based or equipment-free programs. The system automatically generates programs consisting of 10 exercises from warm-up, cool-down, strengthening, and balance categories. The initial program is set at moderate difficulty level, and subsequent programs are automatically adjusted according to perceived difficulty reported after exercise. Through the exercise calendar, history section, and communication module, users can track participation and report technical issues to the research team.

Conclusions: iDEA has been launched in application markets as accessible, user-centered digital health application supporting exercise education for individuals with hearing impairment. With Turkish sign language support, video-based content, and exercise tracking features, it has the potential to provide personalized and sustainable exercise experience.

Keywords: Exercise, Adolescents, Digital Health Technology

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INVESTIGATION OF MUSCLE OXYGEN SATURATION IN CHILDREN WITH MUSCULAR DYSTROPHIES

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Abstract

Purpose: Muscle oxygen saturation (SmO2) is a useful indicator of muscle energy metabolism. Although it is known that energy metabolism is impaired in muscular dystrophies (MD), there is limited information on SmO2. This study aimed to determine the SmO2 value in children with MD and establish its relationship with functional performance.

Methods: Ten children with MD and ten typically developing (TD) children were included in this study. Demographic characteristics were obtained. SmO2 was measured in the rectus femoris muscles on both sides of the body using a Moxy Monitor. SmO2 was recorded during both a resting period and a six-minute walk test (6MWT).

Results: The mean age of the children with DMD and the TD children was 11.55 ±3.13 and 11.12 ±2.08 years, respectively ($p>0.05$). The two groups did not differ in terms of resting SmO_2 ($p>0.05$). The SmO_2 was lower during the 6MWT than the during rest in children with MD (6MWT: 53.78% vs rest: 58.48%, $p=0.036$). The SmO_2 of TD children was similar both during the 6MWT and at rest (6MWT: 59.50% vs rest: 60.33%, $p>0.05$). There was no correlation between SmO_2 and 6MWT distance in children with MD ($p>0.05$).

Conclusions: These results suggest that children with MD are unable to meet the increased demand placed on their energy metabolism unlike healthy children. However, SmO2 may not provide additional insight into functional performance in MD.

Keywords: Muscle, Oxygen Saturation, Children, Muscular Dystrophy, Physical Functional Performance

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WEARABLE TECHNOLOGIES AND THEIR USE IN REHABILITATION

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Abstract

Purpose: Wearable technologies have become increasingly important in healthcare in recent years due to their potential to monitor health status, support rehabilitation processes, and improve functional outcomes. Especially in neurological rehabilitation, technology-assisted interventions play a critical role in enhancing motor learning, increasing patient motivation, and enabling objective assessment. This review aims to summarize the development of wearable technologies and discuss their clinical use and potential benefits in rehabilitation practice.

Methods: This study was designed as a narrative review. Relevant literature on wearable technologies, rehabilitation technologies, and their applications in neurological rehabilitation was examined. The review focuses on commonly used technology-based rehabilitation approaches such as functional electrical stimulation, robotic rehabilitation, virtual reality applications, biofeedback systems, brain–computer interfaces, and telerehabilitation. The clinical contributions, advantages, and limitations of these systems were evaluated based on current literature.

Results: Wearable and technology-assisted rehabilitation systems provide significant advantages such as continuous monitoring, objective data collection, increased patient engagement, and individualized treatment planning. These technologies support motor relearning through repetitive, task-oriented training and real-time feedback. Furthermore, wearable systems allow remote monitoring and facilitate access to rehabilitation services independent of time and location. However, factors such as infrastructure requirements, data interpretation challenges, and the need for user training remain important considerations.

Conclusions: Wearable technologies represent a promising component of modern rehabilitation by improving treatment effectiveness, accessibility, and patient participation. Their integration into rehabilitation programs may enhance functional recovery and quality of life, particularly in neurological populations. Future studies should focus on standardization, clinical effectiveness, and long-term outcomes of wearable rehabilitation technologies.

Keywords: Wearable Devices, Digital Health, Neurological Rehabilitation

THE RELATIONSHIP BETWEEN LANDING ERROR SCORING SYSTEM AND KINESIOPHOBIA, PLANTAR PRESSURE DISTRIBUTION, AND TRUNK ENDURANCE IN PATIENTS AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

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Abstract

Purpose: Determining the factors that affect LESS scoring, a reliable method of predicting possible lower extremity injuries, and strengthening these factors if necessary, raises the question of whether we can prevent or reduce the risk of lower extremity injuries ending an athlete's sports career prematurely.

This study investigated the relationships between kinesiophobia, which is frequently observed in individuals undergoing anterior cruciate ligament reconstruction; trunk endurance, which is an important component of the kinetic chain; foot plantar load distribution, which is likely to change due to lower extremity biomechanics following surgery; and LESS scoring, which plays a key role in preventing lower extremity injuries and evaluating jump landing movement patterns.

Methods: Our study was a non-interventional, cross-sectional and comparative study. The participants are recruited mainly from German Sport University. Kinesiophobia (fear of movement/re-injury), plantar pressure distribution, trunk endurance and jump-landing movement patterns were measured using the "Tampa Kinesiophobia Scale", "Emed Pedobarography", the "Core Endurance Test" and the "Landing Error Scoring System (LESS)", respectively.

Results: Our study included a total of 30 subjects, comprising 19 healthy individuals and 11 patients who had undergone anterior cruciate ligament reconstruction. No statistically significant correlations were found between kinesiophobia, plantar pressure distribution, trunk endurance, and jump-landing movement patterns ($p>0.05$).

Conclusions: The landing error scoring system is not associated with fear of movement, trunk endurance or foot plantar pressure distribution in patients with anterior cruciate ligament injuries. This may be because impaired landing movement patterns are corrected through rehabilitation after anterior cruciate ligament reconstruction.

Keywords: Anterior Cruciate Ligament Reconstruction, Kinesiophobia, Plantar Pressure Distribution, Trunk Endurance

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INVESTIGATION OF ARTIFICIAL INTELLIGENCE ATTITUDES AND INDIVIDUAL INNOVATIVENESS LEVELS OF HEALTH SCIENCE FACULTY STUDENTS

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Abstract

Purpose: This study aims to determine the artificial intelligence (AI) attitudes, AI literacy levels, and individual innovativeness characteristics of health science faculty students, and to investigate the relationships between these variables.

Methods: The study data were collected using the AI Attitude Scale, AI Literacy Scale, and Individual Innovativeness Scale. A total of 237 individuals were included in the study, and statistical analyses were performed on 217 valid samples. Relationships between variables were analyzed using Pearson correlation, and the predictive effects of AI literacy and innovativeness on AI attitude were evaluated using multiple linear regression analysis.

Results: Participants demonstrated moderate AI literacy (53.78 ± 18.27) and moderate-to-good positive AI attitudes (63.27 ± 19.95). Individual innovativeness scores were above moderate (66.86 ± 21.95). A strong, positive, and statistically significant relationship was found among all variables ($p < 0.001$). The regression model was highly significant, explaining 85.8% of the variance in AI attitudes ($R^2 = 0.858$). Both AI literacy ($\beta = 0.375$) and individual innovativeness ($\beta = 0.591$) were significant positive predictors of AI attitude, with innovativeness having a stronger predictive effect.

Conclusions: AI literacy and individual innovativeness are crucial determinants of students' attitudes toward AI. Educational programs should not only aim to increase AI knowledge but also foster innovative thinking to improve AI attitudes effectively.

Keywords: Artificial Intelligence, Students, Health Occupations, Attitude, Health Literacy

THE IMMEDIATE EFFECT OF INTENSE TRAINING ON COGNITIVE STATUS IN YOUTH FOOTBALL PLAYERS

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Abstract

Purpose: This study aimed to investigate the immediate effects of intense training on selective attention, cognitive inhibition, executive functions, and processing speed in youth football players.

Methods: This study included 20 male youth football players (age, 17.7±0.80) competing in the Development League in Sivas. All athletes participated in a single intensive 1-hour exercise program. The Stroop test was used to assess selective attention, cognitive inhibition, executive functions, and processing speed. The Trail Making Test A was used to assess attention and processing speed, and the Trail Making Test B was used to assess executive function and cognitive flexibility. The tests were administered again to the football players before and after the intensive training session.

Results: While participants showed significant improvements in Stroop B ($p= 0.48$) and Stroop C ($p= 0.15$) scores, there was no significant improvement in Stroop A, Trail Making Test A, and Trail Making Test B scores ($p>0.05$).

Conclusions: A single intensive exercise program can improve selective attention, cognitive inhibition, and executive functions in youth football players.

Keywords: Football, Exercise, Cognition

DEVELOPMENT OF A MOBILE EXERCISE APPLICATION FOR CHILDREN WITH HEARING IMPAIRMENT

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Abstract

Purpose: Hearing impairment (HI) can affect communication, language development, motor skills, and participation in physical activity. Currently, no mobile exercise application is known to be specifically designed for children with HI. Sign language (SL) represents a strong element of cultural identity for this population. Presenting exercises through SL may increase participation in physical activity.This study aimed to describe the development process of a mobile exercise application providing Turkish SL support for children with HI.

Methods: Experienced pediatric physiotherapists selected exercises based on physical fitness components. Exercises were categorized (light, moderate, difficult) according to MET values. Children were divided into three age groups (6–10, 11–13, and 14–18 years). Both equipment-free and equipment-based exercise options were provided. Professional Turkish SL videos were recorded for each exercise. SL and exercise videos were combined and integrated into the mobile platform, which was then technically tested and activated across all modules.

Results: The application development was completed, and all videos were integrated. The application is functional regarding its basic features, with a user interface structured appropriately for the target age groups. User experiences and clinical effectiveness will be evaluated in subsequent studies.

Conclusions: This application offers an approach that minimizes the impact of HI on physical activity by reducing communication barriers via SL support and enhancing independent access to exercises. The application has the potential to increase physical activity participation among children with HI. The next phase involves a clinical study to evaluate its usability and contribution to the rehabilitation process.

Keywords: Child, Hearing Loss, Mobile Applications, Physical Activity, Sign Language

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DO GAIT VARIABLES PREDICT FALLS IN STROKE PATIENTS? A SYSTEMATIC REVIEW

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Abstract

Purpose: Falls are one of the most common complications in individuals with stroke, and are frequently assessed using interview-based methods and balance tests. However, these methods may not fully capture the risk of falling. Gait variability, reflecting the spatial and temporal consistency of gait, provides an objective measure of gait quality. This study aimed to investigate whether objectively measured gait variability parameters are associated with fall risk in individuals with stroke.

Methods: This systematic review (CRD420261278069), registered in Prospero in January 2026, included searches of WOS, SCOPUS, PubMed, and Cochrane Library databases. Cross-sectional studies assessing temporal, spatial, or kinetic gait variability and falls in individuals with stroke were included. The entire process was carried out by two independent researchers. Methodological quality was evaluated using the Newcastle-Ottawa Scale (NOS) for cross-sectional studies. The entire process followed the PRISMA guidelines.

Results: 13 studies involving 737 participants were included. Temporal variables such as step duration, stance duration, and swing duration were found to be significantly associated with balance performance, balance confidence, and fear of falling. In contrast, findings for spatial parameters were more heterogeneous. NOS scores ranged from 4 to 8, indicating weak to moderate methodological quality. 11 studies (84.6%) were rated as “Fair,” and 2 (15.4%) were rated as “Poor.”

Conclusions: Temporal variables, particularly step duration variability, are important predictors of fall risk. While spatial parameters show less consistent results, step length variability may still be clinically relevant. Beyond walking speed, gait quality should be considered. Future studies with larger samples and stronger designs are needed.

Keywords: Stroke, Gait variability, Spatiotemporal Kinematics, Falls, Fear of Falling

INVESTIGATION OF FACTORS ASSOCIATED WITH PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOR PARAMETERS IN PATIENTS WITH MULTIPLE SCLEROSIS

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Abstract

Purpose: The aim of this study was to investigate the relationship between physical activity and sedentary behavior parameters and fatigue, cognition, balance, and gait problems, as well as reaction time in patients with Multiple Sclerosis (MS).

Methods: Following the collection of demographic data, physical activity and sedentary behavior were assessed using the ActiGraph GT3X+ accelerometer. For reaction time, simple and complex reaction times and stroke were evaluated using the BlazePod system. Cognition was assessed with the Symbol Digit Modalities Test; balance with the Mini-BESTest; walking speed with the Timed 25-Foot Walk Test; and endurance with the 6-Minute Walk Test.

Results: The mean age of the participants was 37.58±10.33 years, and the mean body mass index was 23.76±4.33 kg/m². A negative correlation was found between total energy expenditure and complex stroke counts (r=-0.312; p=0.031). A negative and statistically significant correlation was found between the number of sedentary bouts and simple stroke counts (r=-0.397; p=0.034). Total sedentary time showed a negative correlation with complex reaction times (r=-0.303; p=0.036) and a positive correlation with Mini-BESTest total score (r=0.411; p=0.003).

Conclusions: Our findings suggest that higher energy expenditure in MS may adversely affect cognitive decision-making performance (complex stroke), likely due to elevated fatigue levels. Conversely, higher sedentary time is associated with shorter reaction times and superior balance scores. This is consistent with the “Energy Conservation Principles” in MS literature, suggesting that patients may optimize neural resources required for motor and cognitive tasks by increasing rest periods. Sedentary behavior in MS patients should not always be interpreted as mere “physical inactivity” but rather as an adaptive strategy used to cope with fatigue. Therefore, rehabilitation programs should prioritize personalized “activity-rest cycles” to preserve cognitive and motor performance, rather than focusing solely on increasing activity levels.

Keywords: Multiple Sclerosis, Sedentary Behavior, Reaction Time, Postural Balance, Cognitive Dysfunction

QUALITY AND RELIABILITY OF PELVIC FLOOR PHYSIOTHERAPY INFORMATION ON INSTAGRAM: ASSOCIATIONS WITH USER ENGAGEMENT

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Abstract

Purpose: This study aimed to evaluate the quality and reliability of Instagram content shared under the hashtag *#pelviktabanfizyoterapisi* and to examine their association with the number of likes.

Methods: On March 10, 2026, the first 50 Instagram posts tagged with *#pelviktabanfizyoterapisi* were included in the analysis. The quality (Global Quality Score) and reliability (modified DISCERN instrument) of the posts were independently assessed by two physiotherapists. Post type, post age, and uploader information were recorded. The relationship between the number of likes and other variables was analyzed using a generalized linear model with a negative binomial distribution.

Results: Most posts (94%) were created by physiotherapists, with 68% in post and 32% in reels formats. Inter-rater reliability was moderate for the total modified DISCERN score (ICC=0.58, 95% CI: 0.27–0.76) and low-to-moderate for the Global Quality Score (ICC=0.49, 95% CI: 0.11–0.71). Reels and post formats received an average of 96.31±168.39 and 81.74±178.61 likes, respectively, and post type was found to significantly affect the number of likes (Wald χ^2=4.08, p=0.043). Although the number of likes was significantly associated with the modified DISCERN score (Wald χ^2=7.76, p=0.005) and post age (Wald χ^2=8.89, p=0.003), no significant association was found with the Global Quality Score (Wald χ^2=0.23, p=0.627).

Conclusions: User engagement with pelvic floor physiotherapy–related Instagram posts appears to be influenced by post characteristics and information reliability rather than overall content quality. Physiotherapists should therefore consider strategies that enhance engagement while maintaining scientific accuracy when sharing health information on social media.

Keywords: Social Media, Online Health Information, DISCERN, Global Quality Score, Pelvic Health

THE EFFECTS OF ANTENATAL EXERCISES DURING PREGNANCY ON SLEEP QUALITY AND PELVIC FLOOR FUNCTIONS

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Abstract

Purpose: This study aimed to examine effects of a 6-week exercise program on sleep quality and pelvic floor function in pregnant women.

Methods: Twenty-one pregnant women (age:28.29±1.87years; gestational age:22.57±3.22weeks) participated in study. Sleep quality was assessed using Pittsburgh Sleep Quality Index (PSQI), and pelvic floor function was evaluated with Pelvic Floor Distress Inventory (PFDI). All participants completed pelvic floor, breathing, strengthening, stretching, and mobilization exercises under the supervision of a physiotherapist for 6 weeks. Assessments were performed before and after intervention.

Results: A significant decrease was observed in total PSQI scores ($p=0.006$), with notable improvements in sleep duration ($p=0.035$) and daytime dysfunction ($p=0.003$). The proportion of women with poor sleep quality decreased from 33.33% to 4.76%. Regarding pelvic floor function, total PFDI scores significantly decreased ($p=0.008$), particularly in urinary symptoms measured by the UDI-6 ($p=0.027$). A borderline improvement was found in colorectal symptoms ($p=0.052$), while no significant change was detected in prolapse symptoms ($p>0.05$).

Conclusions: A physiotherapist-supervised exercise program improved sleep quality and reduced pelvic floor symptoms in pregnant women. Improvements in sleep quality may be attributed to increased muscle strength and flexibility, better posture, and enhanced circulation. The reduction in pelvic floor symptoms is clinically important, as pregnancy-related pelvic floor dysfunction is associated with postpartum incontinence. Therefore, improvements achieved during pregnancy may also provide protective benefits in the postpartum period. Future studies comparing different exercise protocols, extending intervention duration, and evaluating long-term postpartum outcomes will enable a more comprehensive interpretation of these findings.

Keywords: Pregnancy, Antenatal Exercise, Pelvic Floor, Sleep Quality, Physiotherapy

COMBINED EFFECT OF SARCOPENIA AND FRAILTY ON CLINICAL FACTORS IN INDIVIDUALS WITH CHRONIC STROKE

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Abstract

Purpose: This study investigated the impact of sarcopenia and frailty on physical performance, muscle strength, stroke severity, and cognitive status, examining relationships between these factors in individuals with chronic stroke.

Methods: Twenty-six chronic stroke patients (>6 months post-stroke) were included. Sarcopenia risk was evaluated using the SARC-F questionnaire, and physical performance was assessed with the Short Physical Performance Battery (SPPB). Handgrip strength was measured via a Jamar dynamometer, and frailty levels were determined using the Clinical Frailty Scale. Participants were also evaluated using the NIH Stroke Scale (NIHSS), Montreal Cognitive Assessment (MoCA), Hamilton Depression Rating Scale, and Mini Nutritional Assessment.

Results: Mean age was 56.12 ± 15.13 years; mean Body Mass Index was 27.90 ± 3.67 kg/m². Sarcopenia risk was identified in 42.3% (n=11) of the sample. SARC-F scores correlated negatively with SPPB ($r = -0.787$, $p < 0.001$) and paretic hand strength ($r = -0.506$, $p = 0.008$). Stroke severity (NIHSS) correlated negatively with cognitive status (MoCA) ($r = -0.574$, $p = 0.002$). A strong positive relationship was observed between frailty and stroke severity ($r = 0.682$, $p < 0.001$). The sarcopenia risk group demonstrated significantly lower SPPB scores than those without risk (4.18 vs. 8.67, $p = 0.001$).

Conclusions: The strong negative correlation between SARC-F and physical performance suggests that sarcopenia screening effectively predicts functional prognosis. Since stroke severity impacts both frailty and cognition, rehabilitation should adopt a holistic approach. Assessing sarcopenia, frailty, and cognitive impairment should be established as a standard clinical procedure.

Keywords: Stroke, Sarcopenia, Frailty

ANALYSIS OF POSTURAL BALANCE CHANGES FOLLOWING KNEE OSTEOARTHRITIS AND TOTAL KNEE ARTHROPLASTY

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Abstract

Purpose: Approximately 30% of individuals aged ≥65 fall at least once annually, with up to 40% of these events leading to mortality. Fall risk can be objectively evaluated using osteoarthritis (OA) severity and clinical characteristics following Total Knee Arthroplasty (TKA). The Center of Pressure (COP) is a key indicator of postural control in balance assessment. This study examined the relationship between COP parameters, OA stages, and TKA using computerized analysis.

Methods: A total of 105 patients aged ≥55 years with primary OA were classified according to the Kellgren–Lawrence (K–L) system: Group 1 (K–L 1–2), Group 2 (K–L 3–4), and Group 3 (TKA). Balance parameters were measured using the Techno Body Easy Prokin system.

Results: Significant differences were found between groups in right single-leg static COP and anterior–posterior (AP) COP ($p=0.031$ and $p=0.040$). Eyes-open static COP AP also differed significantly ($p<0.05$). The mean difference in right single-leg COP AP between Group 1 and Group 3 was 23.72 (95% CI: 0.053–47.64; $p=0.053$). No significant difference was observed between Groups 1 and 2, whereas Groups 2 and 3 differed significantly in eyes-open COP AP (-24.45; 95% CI: -48.25 to -0.64; $p=0.042$).

Conclusions: COP changes during right single-leg stance were significant, likely reflecting limb dominance. Static balance stability increased adaptively with OA progression, while a postoperative shift in balance direction (posterior to anterior) was observed. Identifying these biomechanical changes may guide targeted interventions to reduce fall risk in older adults.

Keywords: Knee osteoarthritis, Arthroplasty, Fall risk, Gait analysis, Postural balance

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ASSOCIATION BETWEEN TRUNK POSTURAL SWAY DURING WALKING AND UPPER EXTREMITY DEXTERITY IN INDIVIDUALS WITH PARKINSON'S DISEASE: A CASE–CONTROL STUDY USING GYKO SENSORS

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Abstract

Purpose: The relationship between postural control impairment and upper extremity function in Parkinson's disease remains unclear. This study aimed to investigate the association between trunk postural sway during walking and upper extremity functional performance in individuals with Parkinson's disease and to compare the findings with those of healthy controls.

Method: This cross-sectional case–control study included 31 individuals with Parkinson's disease and 30 age- and sex-matched healthy controls. Trunk postural sway was assessed during a 30-second walking task within a 5-meter pathway using the GYKO Inertial Sensor System. The analyzed parameters were Ellipse Area, Path Length, Mean Distance, RMS Distance, Velocity, and Mean Frequency. Upper extremity functional performance was evaluated using the Nine Hole Peg Test (NHPT).

Results: No significant differences were observed between the groups in age, sex, height, body weight, or body mass index ($p>0.05$). The mean disease duration in the Parkinson group was 3.96±3.70 years. NHPT completion time was significantly longer in the Parkinson group than in healthy controls (32.74±15.49 s vs 22.06±4.10 s; $p<0.001$). Ellipse Area, Path Length, Mean Distance, RMS Distance, and Velocity differed significantly between groups (all $p<0.001$), whereas Mean Frequency did not ($p=0.081$). In the Parkinson group, NHPT time showed significant negative correlations with Ellipse Area ($r = -0.371$, $p = 0.040$), Path Length ($r = -0.368$, $p = 0.042$), RMS Distance ($r = -0.360$, $p = 0.047$), and Velocity ($r = -0.362$, $p = 0.045$). No significant correlations were observed in the control group.

Conclusions: Trunk postural sway parameters during walking were associated with upper extremity manual dexterity in individuals with Parkinson's disease. Lower trunk sway during gait may reflect axial rigidity or a conservative gait strategy rather than improved postural stability, which may partly explain the observed relationship between trunk movement and upper extremity motor performance.

Keywords: Parkinson's Disease, Trunk Sway, Gait, Upper Extremity Dexterity, GYKO Sensor

ASSOCIATION BETWEEN SARCOPENIA SEVERITY, PULMONARY FUNCTION, AND INSPIRATORY MUSCLE STRENGTH IN INDIVIDUALS WITH CHRONIC STROKE

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Abstract

Purpose: This study aimed to investigate the association of sarcopenia severity with pulmonary function and inspiratory muscle strength in individuals with chronic stroke.

Methods: This cross-sectional study included 45 individuals with chronic stroke aged 40–75 years. Sarcopenia severity was determined using the Sonographic Thigh Adjustment Ratio (STAR), calculated from anterior thigh muscle thickness measured by ultrasonography. Pulmonary function was evaluated using spirometry, including forced vital capacity (FVC), forced expiratory volume in one second (FEV_1), peak expiratory flow (PEF), and forced expiratory flow at 25–75% of vital capacity (FEF25–75). Inspiratory muscle strength was assessed using the PowerBreathe K5 device, and the S-index, inspiratory volume, and inspiratory flow were recorded as indicators of inspiratory muscle performance. The relationships between sarcopenia severity, pulmonary function parameters, and inspiratory muscle strength were analyzed using Pearson's correlation analysis.

Results: Moderate positive correlations were observed between the STAR value and FVC, PEF, S-index, and inspiratory volume, whereas low positive correlations were found with FEV_1 and inspiratory flow ($p < 0.05$).

Conclusions: Sarcopenia severity was associated with pulmonary function parameters and inspiratory muscle performance in individuals with chronic stroke. This association may reflect a bidirectional interaction between peripheral muscle mass and respiratory function. Therefore, assessing sarcopenia may help guide rehabilitation planning, and interventions targeting both peripheral muscle strengthening and respiratory function may be beneficial.

Keywords: Inspiratory muscle strength, Pulmonary function, Rehabilitation, Sarcopenia, Stroke

COMPARATIVE BIBLIOMETRIC ANALYSIS OF AUGMENTED AND VIRTUAL REALITY APPLICATIONS IN NEUROLOGICAL REHABILITATION

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Abstract

Purpose: Augmented reality (AR) and virtual reality (VR) technologies have gained increasing attention in neurological rehabilitation. However, comparative trends in scientific productivity and impact between AR and VR remain insufficiently explored. This study aimed to compare global publication trends, citation impact, and research patterns of AR and VR applications in neurological rehabilitation.

Methods: A bibliometric search was conducted in the Web of Science Core Collection database for publications between 2000 and 2025. Search terms included combinations of “augmented reality,” “virtual reality,” and “neurological rehabilitation.” Bibliometric indicators (total publications, total citations, average citations per document, H-index, country productivity, and keyword co-occurrence) were analyzed using VOSviewer and Bibliometrix (R).

Results: A total of 1,248 publications were identified, including 912 (73.1%) VR and 336 (26.9%) AR studies. Publication growth accelerated after 2015, with VR studies increasing by 320% and AR studies by 410% between 2015 and 2024. VR publications accumulated 21,540 citations (mean: 23.6 citations/article; H-index: 68), whereas AR publications received 5,874 citations (mean: 17.4 citations/article; H-index: 39). The most productive countries were the United States, China, and Italy. Stroke rehabilitation represented the largest research area.

Conclusions: VR remains the dominant and more highly cited technology in neurological rehabilitation research. However, AR publications show a faster recent growth rate, indicating increasing scientific interest. Further comparative clinical studies are needed to determine optimal technology integration in neurorehabilitation.

Keywords: Augmented Reality, Virtual Reality, Neurorehabilitation, Bibliometric Analysis, Research Trends