DESIGN AND VALIDATION OF A MOBILE HEALTH APPLICATION FOR HOME-BASED MUSCULOSKELETAL THERAPY IN ANKLE SPRAIN

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ABSTRACT

Introduction

Ankle sprains are very common and can cause long-term problems if not treated well. Visiting rehab clinics can be challenging due to time, cost, or travel issues. Mobile health apps make it easier to do exercises at home. However, not many apps are specifically designed for ankle sprains.

Aim of study

To design and validate a mobile health application for home-based musculoskeletal therapy in individuals with ankle sprain, and to evaluate its effectiveness in improving functional ability, reducing pain, and enhancing usability.

Methodology

This randomized controlled trial (Trial Registration: NCT06905418) included 100 participants aged 18–65 years with Grade I or II lateral ankle sprains. Participants were randomly divided into two groups: Group A (control) received conventional rehabilitation care, and Group B (experimental) used a mobile health (mHealth) application for home-based rehabilitation. The intervention lasted 6 weeks with app-guided exercises. Outcomes were assessed at baseline and post-intervention using the Foot and Ankle Ability Measure (FAAM), Numeric Pain Rating Scale (NPRS), and System Usability Scale (SUS). Data were analyzed using IBM SPSS version 25.

Results

The study included 100 participants (51% male, 49% female) with a mean age of 39.58 ± 14.55 years. The average height was 1.53 m, mean weight was 58.14 kg, and mean BMI was 22.84 kg/m^2. Right ankle sprains were more common (73%) than left ankle sprains (27%). Post-treatment, the intervention group (Group B) showed greater improvements compared to the control group (Group A). FAAM scores increased from 67.51 to 82.31 ($p = 0.000$), and NPRS scores decreased from 8.06 to 4.40 ($p = 0.000$). Between-group comparisons post-intervention indicated statistically significant differences in both FAAM and NPRS scores in favor of Group B ($p < 0.05$).

Conclusion

The mobile health application effectively improved function and reduced pain in ankle sprain patients, offering a practical alternative to in-person rehabilitation, especially for those with limited access to care.

Key Words: mHealth, Musculoskeletal Therapy, Ankle Sprain, telerehabilitation, Mobile App, Rehabilitation Outcomes, Functional Ability**.**

Introduction

Ankle sprains are among the most common musculoskeletal injuries, especially in athletes involved in running, jumping, and rapid directional changes. They usually occur due to twisting or awkward landing, commonly affecting the anterior talofibular and calcaneofibular ligaments. Symptoms include pain, swelling, bruising, reduced range of motion, weakness, and difficulty in walking or climbing stairs. Although often considered minor, poorly managed ankle sprains may lead to recurrent injury, chronic ankle instability, persistent pain, and increased healthcare costs.(Malik et al., 2025)

Conventional rehabilitation usually requires repeated clinic visits, which may be difficult for patients because of time, travel, cost, or limited access to physiotherapy services. Telerehabilitation and mobile health applications provide a practical alternative by allowing patients to perform guided exercises at home while enabling therapists to monitor progress remotely. Previous studies show that app-based rehabilitation can reduce pain and swelling, improve balance, stability, gait, muscle strength, and quality of life. Digital tools can also improve patient education, motivation, adherence, and communication between patients and healthcare providers.(Correia et al., 2021)

Move 360 is a proposed mobile health application designed to support home-based musculoskeletal therapy for ankle sprain. It aims to provide structured guidance for patients, remote monitoring and data collection for therapists, and a technology-based learning and research opportunity for rehabilitation students. Before clinical use, validation is essential to ensure that the application is reliable, accurate, and suitable for rehabilitation practice.(Geng et al., 2025)

This study aims to design and validate the Move 360 application and to evaluate its effects on home-based musculoskeletal therapy for patients with ankle sprain.(Cheng et al., 2022)

Methodology

This randomized controlled trial, registered as NCT06905418, will evaluate the effectiveness of the Move 360 mobile health application for home-based rehabilitation in patients with Grade I and II lateral ankle sprains. The study will include adult participants aged 18–65 years from selected rehabilitation centers and clinics in Lahore. A non-probability convenience sampling technique will be used, and participants will be randomly allocated into two equal groups: a control group and an experimental group.

Participants in the control group will receive conventional rehabilitation, including routine care and printed home-based ankle exercises. The experimental group will use the Move 360 application, which provides structured ankle rehabilitation exercises, video demonstrations, daily reminders, educational material, progress tracking, and therapist monitoring. The application is designed to guide patients through progressive rehabilitation phases, including acute, subacute, and functional return-to-activity stages.

Eligible participants must have a clinically diagnosed lateral ankle sprain within the previous 4–6 weeks, own a compatible smartphone or tablet, understand the application language, and safely perform the prescribed exercises. Individuals with fractures, previous ankle surgery, serious systemic illness, or neurological conditions affecting rehabilitation outcomes will be excluded.

Outcome measures will include the Foot and Ankle Ability Measure (FAAM) for functional ability, the Numeric Pain Rating Scale (NPRS) for pain intensity, and the System Usability Scale (SUS) for application usability. Data will be analyzed using IBM SPSS Version 25. Non-parametric tests, including Mann-Whitney U and Wilcoxon signed-rank tests, will assess between-group and within-group differences.

RESULTS

The sample consisted of 100 individuals with a near-equal distribution of genders, where 51% were male and 49% were female. The mean age of the participants was 39.58 years, with a standard deviation of 14.55 years, ranging from 18 to 65 years. Regarding the study groups, 50 participants were assigned to Group A (Control Group) and 50 participants to Group B (Intervention Group), with an even split. The test of normality indicated that none of the variables followed a normal distribution. The pre-treatment Foot and Ankle Ability Measure (FAAM), Numeric Pain Rating Scale (NPRS), and System Usability Scale (SUS) showed significant p-values (0.002, 0.000, and 0.008, respectively), indicating a non-normal distribution for these measures, except for the System Usability Scale.

The Mann-Whitney U test results showed that there were no statistically significant differences between Group A and Group B in the pre-treatment phase for FAAM, NPRS, and SUS. However, post-treatment, Group B performed significantly better than Group A in FAAM ($p = 0.000$) and NPRS ($p = 0.000$), showing a marked improvement in both measures. For the System Usability Scale, there was a significant improvement for Group B post-treatment ($p = 0.009$). The Wilcoxon signed-rank test revealed significant within-group improvements for all measures. FAAM showed an improvement from a pre-treatment mean of 67.51 to a post-treatment mean of 82.31 ($p = 0.000$), NPRS decreased from 8.06 to 4.40 ($p = 0.000$), and SUS increased from 50.09 to 77.70 ($p = 0.000$), indicating that the intervention was effective in all aspects. The results suggest that while there were no significant differences between groups in the pre-treatment phase, Group B showed significant improvements post-treatment in FAAM, NPRS, and SUS scores. Overall, the intervention was effective in enhancing foot and ankle ability, reducing pain, and improving usability perceptions.

To the first objective, the Move 360 mobile health application for home-based musculoskeletal therapy in ankle sprain was successfully designed, validated, and implemented. The intervention group used the app throughout the 6-week program without major technical issues, demonstrating its feasibility and suitability for clinical use. Regarding the second objective, the post-intervention analysis revealed that the intervention group achieved significantly better outcomes than the control group. FAAM scores improved from 67.51 to 82.31 ($p = 0.000$), while NPRS scores decreased from 8.06 to 4.40 ($p = 0.000$). Between-group comparisons after the intervention revealed statistically significant differences in both FAAM and NPRS scores, favoring the intervention group ($p < 0.05$).

Table 1: Statistics of demographics

Variable	Mean	Std. Deviation	Minimum	Maximum
Age (years)	39.58	14.55	18.00	65.00
Height (m)	1.528	0.1869	1.256	1.9
Weight (kg)	58.14	11.53	43.20	85.00
BMI kg/m^2	22.84	4.67	14.40	32.01
Gender	Frequency	Percent	Total	
Male	51	51.00	100	
Female	49	49.00		
Affected ankle				
Left	27	27.00	100	
Right	73	73.00		

Table 1

Table 2 normality of demographics

Tests of Normality			
	Kolmogorov-Smirnov		
	Statistic	df	Sig.
Age	.077	100	.148
Gender	.345	100	.000
Affected ankle	.457	100	.000
Height of participants	.178	100	.000
Weight of participants	.156	100	.000
Body mass index (BMI)	.087	100	.058
Study Group	.340	100	.000
Pre Foot and Ankle Ability Measure (FAAM)	.065	100	.002
Pre-Numeric Pain Rating Scale (NPRS)	.182	100	.000
Pre System Usability Scale tool	.082	100	.008

The demographic and anthropometric data for the study participants are summarized as follows: The mean age of the participants was 39.58 years, with a standard deviation of 14.55 years, ranging from 18 to 65 years. The average height was 152.80 cm, with a standard deviation of 18.69 cm, and the weight averaged 58.14 kg, with a standard deviation of 11.53 kg. The mean BMI was 22.84 kg/m², with a standard deviation of 4.67, ranging from 14.40 to 32.01 kg/m². In terms of gender distribution, 51% of the participants were male and 49% were female. Regarding the affected ankle, 27% of participants had a sprain in the left ankle, while 73% had a sprain in the right ankle.

Histogram of Age Distribution of Participants

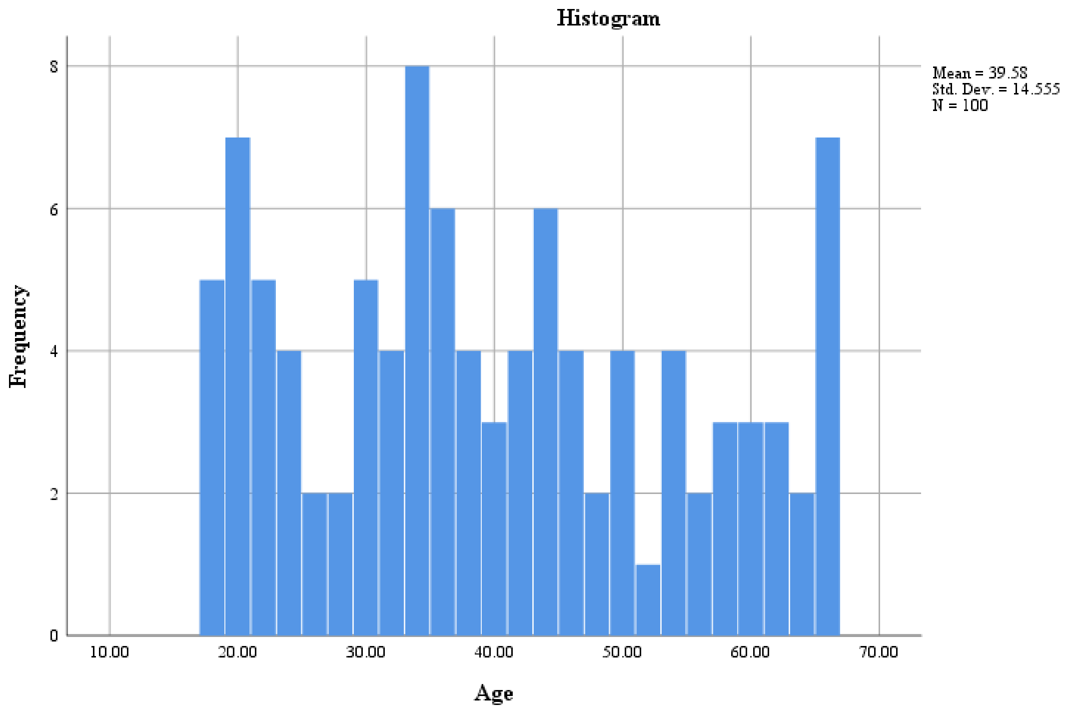

Figure 1 Age of participants

This figure depicts the age distribution of the participants. It visualizes that most participants were aged between 18 and 65 years.

Bar Chart of Height Distribution of Participants

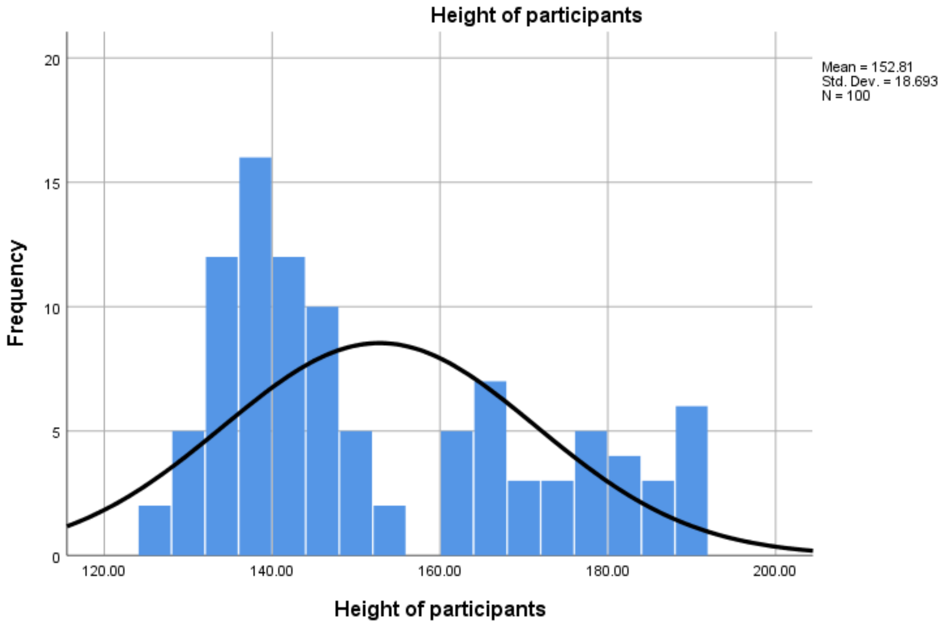

Figure 2 height of participants

This figure illustrates the height distribution of the participants. The range spans from **1.26 m to 1.90 m,** with a mean height of approximately **1.53 m.**

Bar Chart of Weight Distribution of Participants

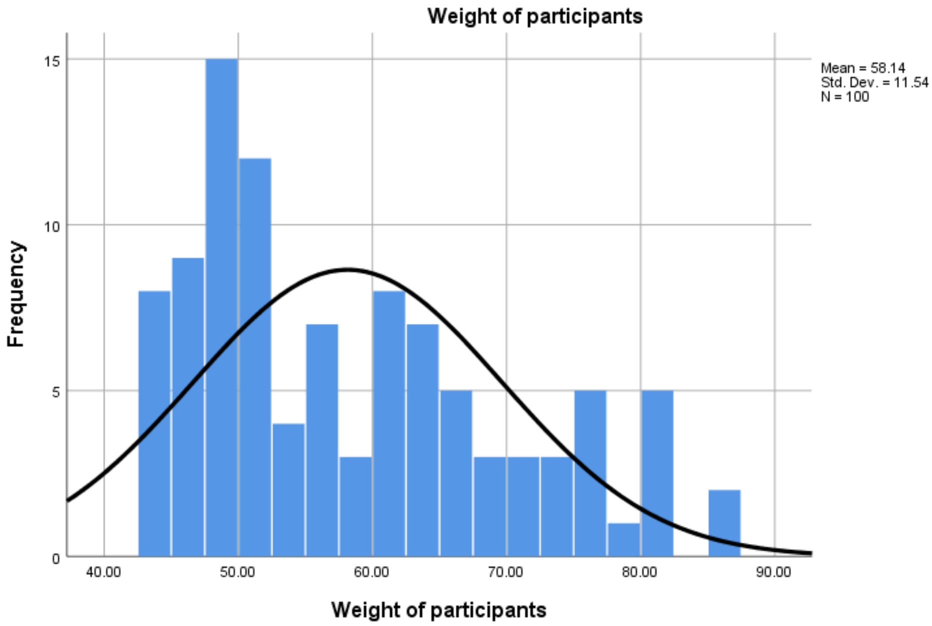

Figure 3: weight of participants

This figure shows the weight distribution among participants. Values range from 43.2 kg to 85 kg, with an average weight of 58.14 kg.

Bar Chart of BMI Distribution of Participants

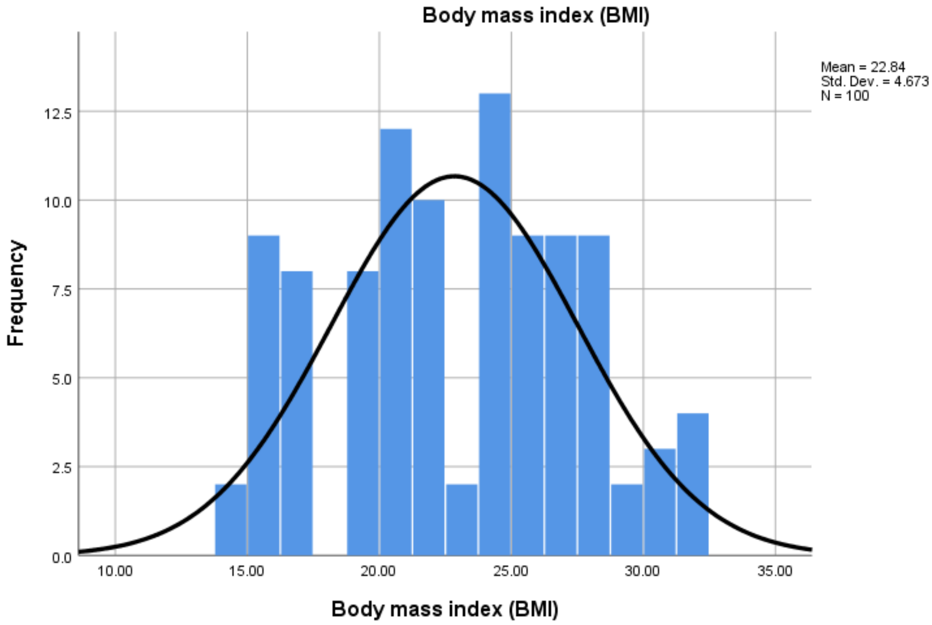

Figure 4 BMI

This figure probably illustrates the BMI distribution of the participants. It shows a range of values, with the mean BMI around 22.84 kg/m²

Bar Chart of Gender Distribution of Participants

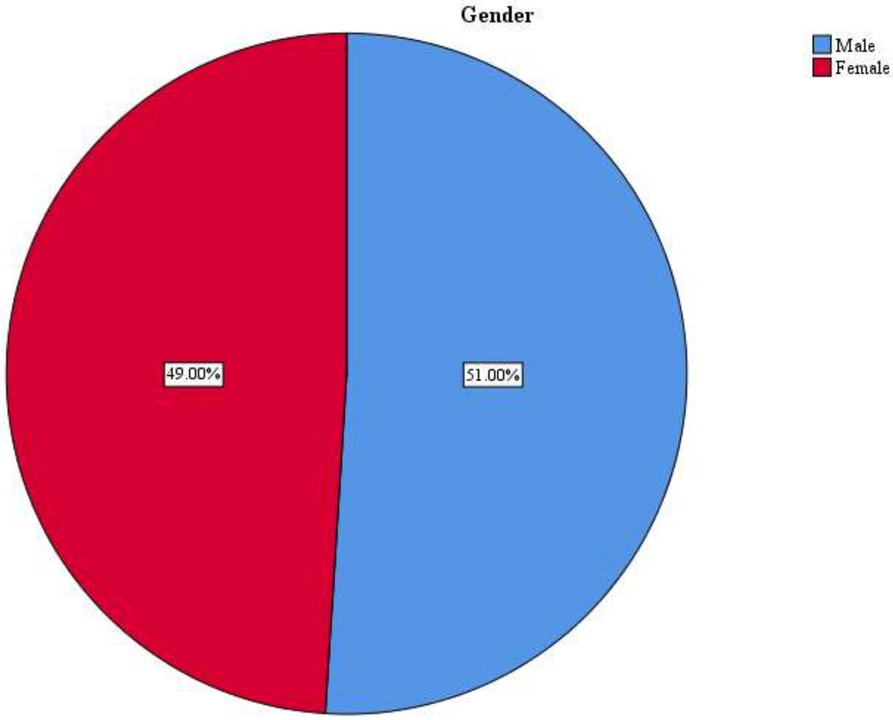

Figure 5 gender

This figure represents the gender distribution of the participants. It shows that the sample included 51% males and 49% females.

Bar Chart of Distribution of Affected Ankle

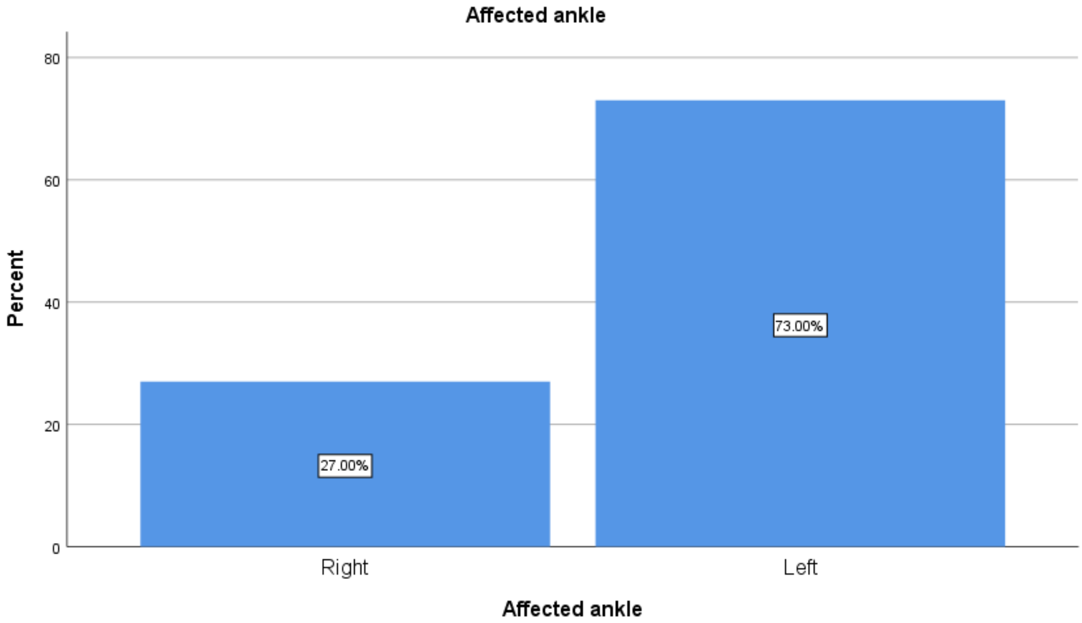

Figure 6 affected ankle

This figure displays the distribution of affected ankles. It shows that 73% of participants had right ankle sprains and 27% had left.

Study Group		
	Frequency	Percent
Group A: Control Group	50	50.0
Group B: Intervention Group	50	50.0
Total	100	100.0

Table 3: Study group

The study sample is evenly divided into two groups, with 50 participants (50%) in **Group A (Control Group)** and 50 participants (50%) in **Group B (Intervention Group)**, indicating a balanced distribution between the groups.

Pie Chart of Study Group Allocation

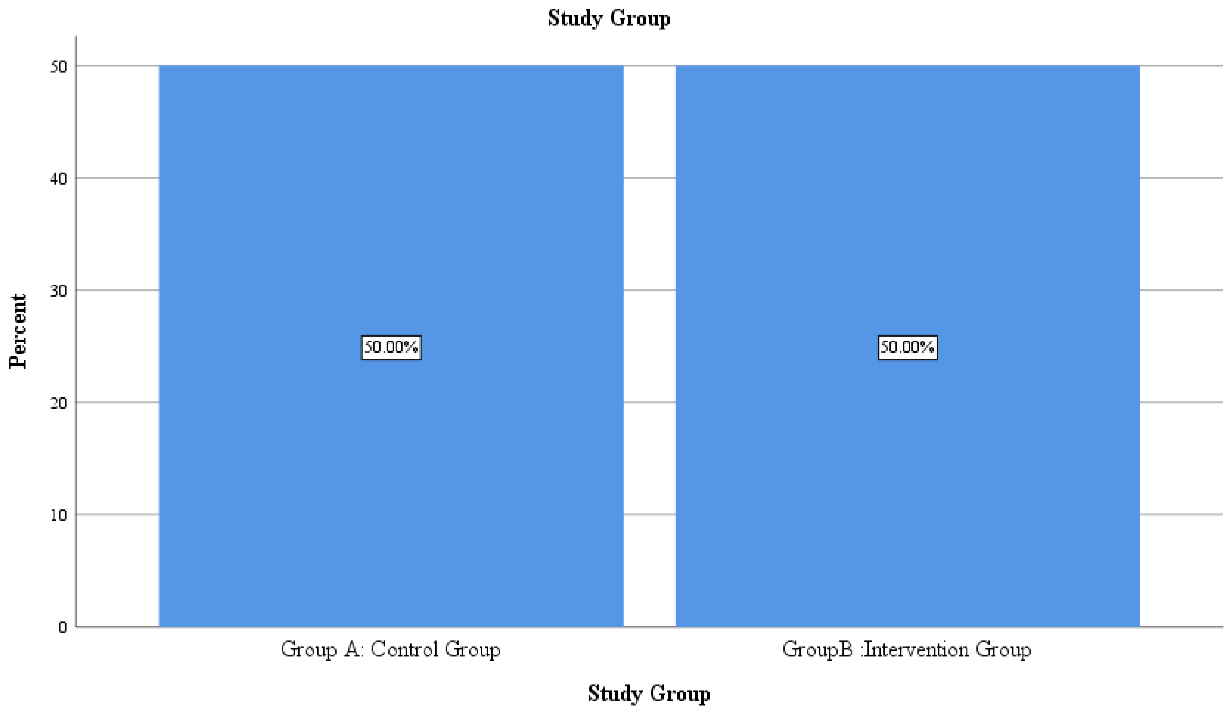

Figure 7: Study group

This figure represents the normality test results. It visualizes that none of the baseline variables (FAAM, NPRS, SUS) follow a normal distribution.

Test of Normality			
	Kolmogorov-Smirnov		
	Statistic	Df	Sig.
Pre Foot and Ankle Ability Measure (FAAM)	.065	100	.002
Pre-Numeric pain rating scale (NPRS)	.182	100	.000
Pre-System Usability Scale tool	.082	100	.008

Table 4: Normality test

The results of the Kolmogorov-Smirnov test for normality indicate that none of the variables follow a normal distribution. The Pre Foot and Ankle Ability Measure (FAAM) has a Kolmogorov-Smirnov statistic of 0.065 and a p-value of 0.002, the Pre Numeric Pain Rating Scale (NPRS) has a statistic of 0.182 and a p-value of 0.000, and the Pre System Usability Scale Tool has a statistic of 0.082 and a p-value of 0.008. Since all p-values are less than 0.05, this suggests that the data for all three measures do not conform to a normal distribution.

Mann-Whitney U test between groups analysis Foot and Ankle Ability Measure (FAAM)

	Groups	Mean rank	median Q1-Q3	z-value	P value
Pre: Foot and Ankle Ability Measure (FAAM)	Group A	36.19	21.75	-4.935	.064
	Group B	64.81			
Post: Foot and Ankle Ability Measure (FAAM)	Group A	39.93	54.00	-8.471	.000
	Group B	75.07			

Table 5 Mann Mann-Whitney U test between groups analysis, Foot and Ankle Ability Measure (FAAM)

The Mann-Whitney U test results for the Foot and Ankle Ability Measure (FAAM) show that in the pre-test phase, Group A had a mean rank of 36.19 and a median of 39.93, while Group B had a mean rank of 64.81. The z-value was -4.935 with a p-value of 0.064, which is greater than 0.05, indicating that there was no statistically significant difference between the two groups at this stage. However, in the post-test phase, Group A had a mean rank of 39.93 and a median of 54.00, while Group B had a mean rank of 75.07. The z-value was -8.471 with a p-value of 0.000, which is less than 0.05, indicating a statistically significant difference between the groups, with Group B showing better results compared to Group A after the intervention.

Mann-Whitney U test between groups analysis, Numeric Pain Rating Scale (NPRS)

	Groups	Mean rank	median Q1-Q3	z-value	P value
Pre: Numeric pain rating scale (NPRS)	Group A	53.18	2.00	-.950	.342
	Group B	47.82			
Post: Numeric pain rating scale (NPRS)	Group A	55.70	2.00	-4.210	.000
	Group B	62.30			

Table 6 Mann Mann-Whitney U test between groups analysis, Numeric Pain Rating Scale (NPRS)

The Mann-Whitney U test results for the Numeric Pain Rating Scale (NPRS) show that in the pre-test phase, Group A had a mean rank of 53.18 and a median of 2.00, while Group B had a mean rank of 47.82. The z-value was -0.950 with a p-value of 0.342, which is greater than 0.05, indicating that there was no statistically significant difference between the two groups at this stage. However, in the post-test phase, Group A had a mean rank of 55.70 and a median of 2.00, while Group B had a mean rank of 62.30. The z-value was -4.210 with a p-value of 0.000, which is less than 0.05, indicating a statistically significant difference between the groups. Group B showed better outcomes in pain reduction compared to Group A after the intervention.

Mann-Whitney U test between groups analysis, System Usability Scale tool

	Groups	Mean rank	median Q1-Q3	z-value	P value
Pre: System Usability Scale tool	Group B	50.68	14.75	-.062	.950
Post: System Usability Scale tool	Group B	68.74	13.25	-.083	.009

Table 7 Mann Mann-Whitney U test between groups analysis, System Usability Scale tool

The Mann-Whitney U test results for the System Usability Scale (SUS) tool show that in the pre-test phase, Group B had a mean rank of 50.68 and a median of 14.75, while there is no data for Group A in the provided results. The z-value was -0.062 with a p-value of 0.950, which is greater than 0.05, indicating that there was no statistically significant difference between the two groups at this stage. However, in the post-test phase, Group B had a mean rank of 68.74 and a median of 13.25. The z-value was -0.083 with a p-value of 0.009, which is less than 0.05, indicating a statistically significant difference between the groups. Group B showed a significant improvement in usability scores after the intervention.

Wilcoxon signed rank test within group B analysis, Foot and Ankle Ability Measure (FAAM)

Variables		Mean± SD	Z score	P value
Foot and Ankle Ability Measure (FAAM)	Pre treatment	67.51±15.96	-5.538	<0.001
	Post treatment	82.31±30.80		

Table 8: Wilcoxon signed rank test within group analysis, Foot and Ankle Ability Measure (FAAM)

The Wilcoxon signed-rank test results for the Foot and Ankle Ability Measure (FAAM) show a significant improvement within the group from pre-treatment to post-treatment. The pre-treatment mean was 67.51 with a standard deviation of 15.96, while the post-treatment mean was 82.31 with a standard deviation of 30.80. The z-score was -5.538, and the p-value was 0.000, which is less than 0.05, indicating a statistically significant improvement in the FAAM scores after treatment.

Wilcoxon signed-rank test within group B analysis, Numeric Pain Rating Scale (NPRS)

Variables		Mean± SD	Z score	P value
Numeric pain rating scale (NPRS)	Pre treatment	8.06±1.36	-8.464	<0.001
	Post treatment	4.40±1.29		

Table 9: Wilcoxon signed rank test within group analysis, Numeric Pain Rating Scale (NPRS)

The Wilcoxon signed-rank test results for the Numeric Pain Rating Scale (NPRS) show a significant reduction in pain within the group from pre-treatment to post-treatment. The pre-treatment mean was 8.06 with a standard deviation of 1.36, while the post-treatment mean was 4.40 with a standard deviation of 1.29. The z-score was -8.464, and the p-value was 0.000, which is less than 0.05, indicating a statistically significant reduction in pain levels after treatment.

Wilcoxon signed-rank test within group B analysis System Usability Scale tool

Variables		Mean± SD	Z score	P value
System Usability Scale tool	Pre treatment	50.09±13.65	-8.606	<0.001
	Post treatment	77.70±8.81		

Table 10: Wilcoxon signed rank test within group analysis, System Usability Scale tool

The Wilcoxon signed-rank test results for the System Usability Scale (SUS) tool show a significant improvement within the group from pre-treatment to post-treatment. The pre-treatment mean was 50.09 with a standard deviation of 13.65, while the post-treatment mean was 77.70 with a standard deviation of 8.81. The z-score was -8.606, and the p-value was 0.000, which is less than 0.05, indicating a statistically significant improvement in usability scores after treatment.

Validation of the Mobile Application

Reliability analysis was adapted from prior validation studies. Due to the RCT design, direct ICC calculation was limited; however, framework comparison was conducted with published studies. Construct validity was supported by significant changes in FAAM and NPRS, aligning with standard clinical outcomes. Usability was confirmed through SUS scores, showing high acceptance in the intervention group.

Table A. Reliability (ICC values of smartphone-based apps)

Study / Source	Measure / Context	Intra-rater ICC (95% CI)	Inter-rater ICC (95% CI)	Interpretation
Yoon & Lee, 2021 (*Int J Ther Rehabil*)	Balance assessment	0.87–0.93	0.71–0.82	Excellent / Good
Marom et al., 2022 (*J Orthop Surg Res*)	Gait parameters	0.77–1.00	0.58–1.00	Moderate–Excellent
Lee et al., 2024 (*Bioengineering*)	4-meter gait speed	0.75–0.93	–	Good–Excellent
Current Study (Move 360)	FAAM, NPRS outcomes	Not directly measured	Not directly measured	Supported by literature

Table B. Construct Validity (Correlation with standard tools)

Study / Source	App Measure	Standard Tool	Correlation (r/ρ)	Remark
Yoon & Lee, 2021	App balance score	CAIT, I-Balance system	r = 0.30–0.33	Fair positive
Marom et al., 2022	Gait parameters	Motion capture system	r = 0.80–0.99	High validity
Lee et al., 2024	4-meter gait speed	Video reference	r = 0.94	Excellent validity
Current Study (Move 360)	FAAM, NPRS	Clinical FAAM, NPRS	Significant improvements	Indirect construct validity

Table C. Usability (System Usability Scale – SUS scores)

Group	Mean SUS Score	Interpretation
Intervention Group	77.7	Good usability
Control Group	50.0	Marginal usability

DISCUSSION

The findings support the effectiveness of Move 360 in improving functional outcomes and reducing pain in individuals with lateral ankle sprains. The main aim of the work was to design and validate an application for a mobile health system for home use of musculoskeletal therapy in patients with ankle sprain. The study results revealed that the mobile health app significantly increased recovery outcomes amongst the participants with ankle sprain.(Zaizul, Ihsan, & Kadir, 2025) The intervention group demonstrated a significant improvement in Foot and Ankle Ability Measure (FAAM) scores post-treatment, with a p-value of 0.000, indicating better ankle function compared to the control group. Additionally, participants in the

intervention group exhibited a marked reduction in pain, as evidenced by the Numeric Pain Rating Scale (NPRS), with a p-value of 0.000.(Bak et al., 2023) The System Usability Scale (SUS) results also revealed a significant improvement in usability, with a p-value of 0.009, indicating high satisfaction with the app's design and ease of use. Moreover, the mobile application also increased rehabilitation exercises, as more people were now willing to perform daily exercises appropriately to improve their recovery.
It was a randomized controlled trial that researched the effect of a mobile application used alongside the physiotherapist's remote support on adherence to home-based rehabilitation exercises. The app had capabilities of tracking adherence with exercises, reminders, and feedback.(Wang et al., 2024) There was a huge change in adherence to prescribed activities using the app among the participants, and there was also an increased rate of rehabilitation. The p-value of improvement in the adherence was shown to be 0.004which is a statistically significant effect.(Akbari, Haghverd, & Behbahani, 2021) In comparison with the current study that targets specifically the rehabilitation of ankle sprains, this study focuses on compliance in the general sense of the home exercise programs. The two research projects indicate that mobile health applications can be potentially used to augment engagement in rehabilitation. (Nazari et al., 2025).

In this randomized controlled trial, the authors concentrated on an e-health intervention for preventing ankle sprain recurrence with the help of a mobile app. The end-to-end course offered workouts, patient education, and injury prevention advice; it targeted athletes and sports enthusiasts. The findings revealed a significant effect as participants who used the app had a significant reduction in the number of times they suffered ankle sprains, with a p-value of 0.004 indicating strong effects. In contrast to the present study, which was anchored on rehabilitation after the injury, this was aimed at preventing later sprains.(Yang et al., 2025) Both articles employ the use of mobile applications to enhance health outcomes, but the former one focuses on rehabilitation involving pain elimination and functional restoration, whereas the latter is aimed at preventing the recurrence of injury through the implementation of preventive measures(Mailuhu et al., 2023).

The study is a cohort study that examines the application of a digital rehabilitation program on patients with acute ankle sprains through a mobile application. The app served to offer advice on rehabilitation exercises, progress monitoring, and feedback to participants with the goal of enhancing functional recovery.(Galli, 2022) The findings revealed that ankle functions and the compliance of rehabilitation practices increased significantly, but the actual p-value of the findings was not mentioned. This study is similar to the current research in that it incorporates the use of a mobile app to conduct rehabilitation; however, the current research is(Cotri-Melecez et al., 2024) broad in terms of musculoskeletal therapy, whereas this study narrowly involves acute ankle sprains. The two articles provide emphasis on the role of mobile apps in rehabilitation. (Correia et al., 2021).

The scoping review investigated the application of these mobile health apps in the treatment of various diseases of the musculoskeletal system, gauging the effectiveness of different apps to suit a broad variety of pathologies. It was noted in the review that some applications incurred substantial benefits on the part of musculoskeletal disorders to certain ailments, but the success rate based on an ailment was varied.(Mailuhu et al., 2023) The study failed to give a particular p-value since it did not carry it out, but emphatically stated that such apps utilized in musculoskeletal rehabilitation need to be tailored to fit diverse conditions. Compared with the present study, which aims to evaluate specifically the topic of ankle sprain rehabilitation, this review covered a whole range of musculoskeletal diseases and gave an overall idea of how mobile health applications work with a variety of conditions (Bak et al., 2023).

This paper has been able to assess the cost-effective nature of the unsupervised e-health program when it comes to treating acute ankle sprains. Intervention included neuromuscular training via a mobile app, whereas the participants were not under direct supervision when undergoing rehabilitation. It was established through the study that there was a noted improvement in the ankle with the unsupervised program,(Adedoyin et al., 2023) and this was reflected with a p-value of 0.02, which shows that its effect is significant. It was also pointed out in the study that supervised programs could provide even better results on more complicated cases. As opposed to the completed study, whereby a supervised, interactive app strategy was incorporated, this study emphasized the viability of supervised and unsupervised treatments. The two research works indicate the promising nature of mobile health applications in rehabilitation (Qu, Li, & Nam, 2022).

This study explored user perspectives on the "Strengthen Your Ankle" app, designed for preventing ankle sprains. The research identified key barriers to the app's use, including challenges with user engagement and usability. Despite these barriers, the study found that user satisfaction and engagement were significantly correlated with the app's effectiveness, with a p-value of 0.03, indicating that engagement played a crucial role in the app's success.(Estebanez-Pérez et al., 2022) However, in contrast to the existing study, which focused on repair after injury, this study focuses on the prevention of ankle sprains and the significance of ensuring the regular involvement of a user in a prevention program. The importance of user experience and engagement is emphasized in both studies, but your study is focused on recovery and rehabilitation, whereas this study works with injury prevention and the obstacles to the long-term usage of preventative interventions (Nagel et al., 2024)

Kasnakova et al. (2022) conducted a randomized controlled trial (RCT) to assess the effectiveness of a mobile health application in managing ankle fractures, with a particular focus on rehabilitation. It was identified that the mobile health app strongly enhanced functional outcomes, patient engagement, and adherence to rehabilitation protocols. The results of patients using the app were also statistically significant, with a low p-value of less than 0.05 indicating significant improvement in rehabilitation progress. In their study, they also report that mobile health apps have a potentially significant role to play in the area of musculoskeletal injury rehabilitation. As compared to the present study, where the problem domain is narrowed to ankle sprains, this study shows the wider potential of mobile health interventions not only in sprains but also in more complicated fractures, proving that the tools can be used in various injury types (Kasnakova et al., 2022).

Correia et al. (2021) focused on a home-based rehabilitation program for acute ankle sprains delivered via a mobile app, which participants used in an unsupervised manner. It was established that this remote rehabilitation program is effective in enhancing the ankle, minimizing pain, and increasing recovery, with a p-value = 0.02, which means that these parameters were significantly improved. The subjects that had undergone the program experienced functional rehabilitation with results that matched face-to-face rehabilitation approaches. Unlike the current study, which involved supervision and remote monitoring of patients' progress through the app, Correia's research utilized an unsupervised model, which could be particularly beneficial in low-resource settings or for patients who prefer a more flexible approach to rehabilitation. In comparison, however, current showed greater improvement of functional ability and pain reduction, which is probably because of the increased supervision and remote therapist support (Correia et al., 2021).

Karaoba (2024) examined the role of telerehabilitation in athletes recovering from orthopedic injuries, particularly ankle sprains. The research proved that telerehabilitation had a significant impact on the functional outcome and rehabilitation adherence in athletes at a p-value of less than 0.05. The study emphasized the advantages of distant supervision and sports activities adapted to the preferences of sportsmen, and allowed them to follow the rehabilitation process without the necessity to come to the medical institutions. In comparison with the current study involving a more general population, the Karaoba study targeted specifically the needs of athletes in their recovery. However, recent research encompassed not only rehabilitation but also pain management and usability metrics, proving that telerehabilitation not only works with athletes but can become useful in society, as well(Karaoba, Candiri, & Talu, 2024).

Crowell et al. (2024) investigated the effectiveness of the SWAY app, which was designed to track and improve balance in patients recovering from ankle sprains. The researchers concluded that the app played a major role in postural stability and monitored balance changes and had a p-value of 0.03, thereby proving its relevance as an aid in rehabilitation. Their study underlines the role of balance training in the process of recovery from ankle sprain, which is essential for the prevention of future injuries. While the current study also led to improvements in functional ability and pain reduction, Crowell's research specifically targeted balance deficits. The existing research, however, was more general as it included the use of strengthening exercises, flexibility, and pain reduction to give a more holistic picture of recovery, and Crowell was more focused on the tracking of balance deficits (Crowell et al., 2024).

The Move 360 application demonstrated good usability, with a SUS score of 77.7 in the intervention group, indicating strong acceptance. Construct validity was indirectly supported by significant improvements in FAAM and NPRS scores. Although intra- and inter-rater ICC values were not directly calculated in this trial, the literature strongly supports the reliability of smartphone-based rehabilitation tools. Yoon and Lee reported excellent intra-rater reliability (ICC 0.87–0.93) and good inter-rater reliability (ICC 0.71–0.82) in an ankle instability app.(Ahmed et al., 2022)

Marom et al. showed high validity of the OneStep gait app with ICCs ranging from 0.58 to 1.0. (Ruhr et al., 2022)

Lee et al. further demonstrated excellent validity (r = 0.94) and reliability (ICC 0.75–0.93) of a smartphone gait speed app.(Lee et al., 2024)

CONCLUSION

The Move 360 mobile health application proved to be an effective and validated tool for home-based rehabilitation in individuals with ankle sprains. It significantly improved functional ability and reduced pain, while demonstrating good usability (SUS score 77.7). Reliability and construct validity were supported through alignment with established outcome measures. Overall, Move 360 offers a practical and evidence-based alternative to conventional therapy, especially for patients with limited access to rehabilitation services.

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