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Research Article

Kinesio Taping and Corrective Footwear Foot Pain

A Study to Assess the Combined Effectiveness of Kinesio Taping and A Corrective Footwear for the Ward Nurses with Foot Pain

Nirpana Gurung[1], Abhijit Dutta[2*], Shalaka Bhattacharyya[3] and Abhijit Kalita[4]

[1]*MPT Scholar, Program of Physiotherapy, Assam Down Town University,*

[2] *Dean Faculty of Paramedical Sciences Assam down town University*

[3]*Assistant Professor, Faculty of Paramedical Sciences, Assam Down Town University*

[4]*Assistant Professor, Faculty of Paramedical Sciences, Assam down town University*

Abstract: Foot pain is an abnormal pain and discomfort in one or more parts of the foot, like heels, arches, and soles. Minor injuries to the foot, repetitive stress or overuse, and inappropriate footwear are found to be the cause. Foot pain has reached up to 55.9% generally in the ones who are more engaged in walking and standing. Previous studies have shown that kinesio taping helps prevent injuries and reduce pain. Since footwear is only an interface between the ground and the foot, we combine kinesio taping with corrective footwear to see the impact. Our study aims to determine the combined effectiveness of kinesio taping and corrective footwear for ward nurses with foot pain. Through this study, we aim to see whether kinesio taping and corrective footwear help reduce pain for ward nurses with foot pain because nurses are at a higher risk as their profession demands more standing and walking. It was an experimental design study where subjects were randomly assigned into two groups- Group A (kinesio taping and corrective footwear) and Group- B (conventional exercise) for three weeks. The numerical Pain Rating Scale (NPRS) was used to measure pain score, Foot Function Index (FFI) to measure pain in terms of function and disability, the Navicular Drop Test (NDT) to measure pronation of the foot and wet test (an observational test) to see the arch of the foot - normal, flat or high arch. statistical analysis showed NPRS mean score for group A is 2.26 and for group B is 3.11, FFI score for group A is 13.00. Group B is 22.00. Both NPRS and FFI were highly significant ($p<0.01$). NDT is significant at a 1% probability level ($p=.005< 0.01$), as the mean score remained the same pre and post-treatment. All the interventions have brought about some improvement in each group post-treatment based on the mean score, but its significance varies. The intervention used in Group-A showed better results in alleviating pain. It is concluded that kinesio taping and corrective footwear were more effective in reducing pain among the nurses.

Keywords: foot pain, kinesio taping, corrective footwear, NPRS, FFI, NDT, wet test.

***Corresponding Author**

Prof.(Dr.) Abhijit Dutta , Dean Faculty of Paramedical Sciences Assam down town University

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1. INTRODUCTION

Foot pain is a distressing sensory and emotional sensation that occurs when any tissue distal to the tibia or fibula is thought to have been damaged, which leads to pain and discomfort in one or more parts of the foot, like heels, arches and soles. As foot pain is complicated, diagnosing its exact cause and source is difficult. Though it impairs the mood and hampers the quality of life, people rarely seek professional attention to it[1]. Etiology of foot pain includes direct trauma and musculoskeletal overload[1], high heels[2], tight shoes[2], hyper pronation of foot [2,3], weak toe flexors[4], Achilles tendon shortness or tightness[5,] plantar fasciitis[6, -,9,] obesity[10]. Risk factors include occupation like prolonged standing[11], aging, obesity, and inappropriate footwear [12]. Foot pain is a common problem among nursing professionals. They are included in situations where their feet are exposed to stress for longer durations when engaged in prolonged walking and standing, often with poorly fitted footwear[13,14]. Prevalence of foot pain in the general population ranges from 17 – 24 % in adults >18year rising to 42% in adults > 65 years[15-18]. The prevalence rate among nurses at the university hospital in Japan was 23 – 51%[19,] Daraiseh et al., in 2003, reviewed several studies and investigated the Prevalence of foot problems ranging from 3.7 to 40%[20]. The self-reported ankle–foot pain among nurses was 43.7% among nurses working in Ayder Comprehensive Specialized Hospital, Tigray, Ethiopia, and 43.8% of nurses with foot and ankle musculoskeletal disorder was found in the survey done by Lloyd F Reed et al. in 2014[13,21]. In India, 59.5% of the nurses reported the occurrence of MSD, with 27.0% suffering from foot/ankle pain[22]. In Maharashtra, 89.1% of nurses had experienced work-related musculoskeletal pain, in 7.6% had foot pain[23]. Diagnosis includes history[24,25] and physical examination[10], plain radiographs[26] provide information about the foot's bony structures and alignment. MRI for any soft tissue findings. Ultrasound can identify fascial thickenings and soft tissue edema. Nerve conduction velocity and electromyography testing can objectively delineate the severity of compression neuropathy around the foot and ankle and diagnose spinal radiculopathy or peripheral neuropathy[27,28]. Kinesio tape (KT) is an elastic therapeutic tape used in various musculoskeletal conditions and settings like sports by athletes, in clinical, rehabilitation, and orthopedic departments, and in physical therapy[29,30]. Chiropractor Dr. KensoKase introduced KT in 1970 in Japan[30]. According to Dr. KensoKase, KT will provide benefits for 3-4 days after its application and also claimed that by applying kinesiotaping, the physiological effect would decrease pain by stimulating the neurological system[31,32]. When standing, footwear is only the interface between the body and the ground, so any alteration in the styling and fit of the footwear can influence the forces acting through the body, posture, and movement. It will lead to pressure under the foot, discomfort, and accelerate the chances of foot pain[11, 33]. An ideal shoe bears all the forces to provide optimum comfort, function, and foot appearance. The function of a shoe is to protect our foot, transfer our body weight to the ground, to provide foot stability and foundation for foot orthosis[34]. The midsole of the footwear provides cushion, stability, and motion control. Midsole components of different densities can be placed or positioned in the footwear to limit the amount of pronation or supination [35]. By better understanding the footwear needs of workers, manufacturers may be able to produce footwear that will meet the requirements of the people who wear them[16]. Though foot health is important, research on low back pain in nurses is comparatively low. Foot health has received less attention, and the Prevalence of foot pain is increasing among nurses[36]. Specifically, footwear-related factors among clinical nurses have received less attention[19]. Since the combined studies of kinesio tape and corrective footwear currently remain lacking, this study is designed to determine the combined effectiveness of kinesio taping and corrective footwear among ward nurses with foot pain.

2. MATERIALS AND METHODS

2.1. Study design

The study was an experimental one approved by the Institutional Research and the ethical committee. However, all the experimental procedures were to the university's guidelines and were approved by the ethical committee with memo no: Adtu/Ethics/stdnt-lett/2022/34.

2.2. Participants

Several 30 subjects, only ward nurses with foot pain fulfilling the inclusion and exclusion criteria, were recruited for the study. Thirty subjects were allocated into Group A (kinesio taping and corrective footwear) and Group B (conventional exercises). The study was conducted in a nursing station of different wards, Down Town Hospital Guwahati.

2.3. Inclusion criteria

Only ward nurses (both genders) with foot pain, 20 - 50 years, no involvement in any sports activity during this study, intact sensory-motor function in the lower limbs, no history of any ankle injury or lower limb surgery, taking no sedative medication.

2.4. Exclusion criteria

Nurses with foot deformities, known pregnant women, recent surgeries and trauma of ankle–foot**,** allergy to tape**,** >50 years and <20 years.

2.5. Outcome measures

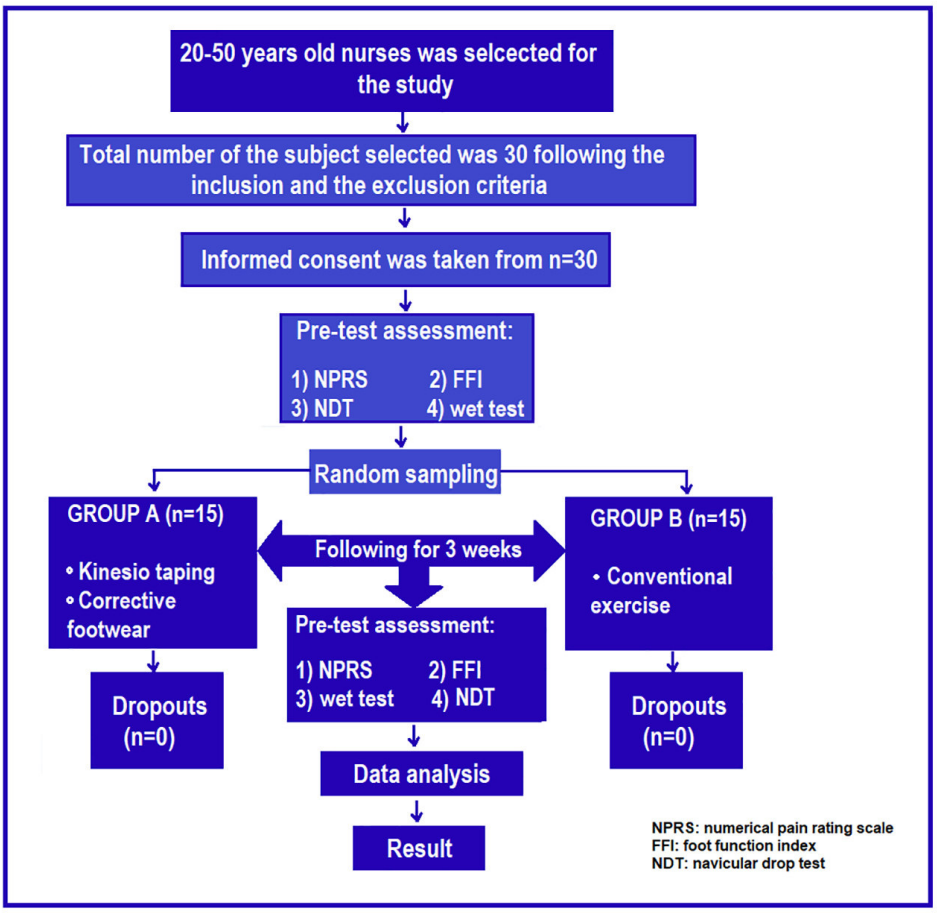
1)Numerical pain rating scale (NPRS)- it is used to indicate the intensity of pain over the past 24 hours on a scale of 0(no pain) to 10(worst pain).
2)Foot function index (FFI) -to measure function in terms of pain, disability, and activity restriction using a questionnaire method.
3)Navicular drop test (NDT) measures the medial arch height by measuring the height of the navicular tubercle in sitting and standing positions. If the difference between the two is >10mm, it indicates hyper-pronation of the foot.
4)Wet test- here, it is only used as an observational test to see the foot type normal(medium)arch, flat (low) arch, and high arch. [this test was not included in the parameter]

2.6. Procedure

The subject was assigned to two groups, Group A and Group B – each group comprising 15 subjects by random sampling. Group A (Kinesio Taping and Corrective footwear) and Group B (Conventional exercise). Those fulfilling the criteria were explained in detail about the purpose of the study, and

then the subjects willingly gave their consent by signing over the consent form. Once they had signed in an informed consent form, for each subject, pre-test and post-test were conducted on both Group A and B by numerical pain rating scale (NPRS)[37] for pain, foot function index (FFI)[38] for pain in terms of function and disability, navicular drop test (NDT)[39] for pronation and wet test technique[40] to determine the arch of the foot - normal(medium)arch, flat (low) arch, high arch. The data about the outcome measure were collected on day 0 and week 3 of the intervention.

- ***Flow Chart of the Participants Through the Study***



2.7. *Intervention*

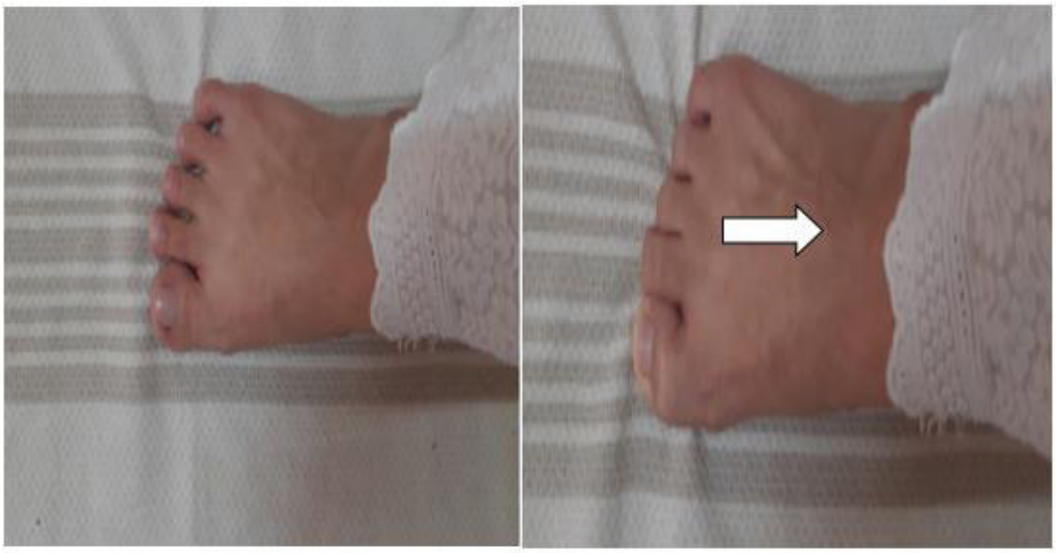
Kinesio Taping and Corrective footwear treated group A, and Conventional exercises treated Group B. Both groups were treated for 3 weeks only for the taping, and it was renewed 3 times a week for 3 weeks in the nursing station, Down Town hospital Guwahati. Kinesio tape (KT) was applied on a prone lying position with the knee extended and ankle dorsiflexed (figure 1). Taping started from the gastrocnemius muscle and progressed toward the Achilles tendon. After passing the heel, it was cut into four divisions and attached to the foot's dorsal aspect, the metatarsal area (figure 2). A second length of tape was attached to the lateral malleolus in the ankle dorsiflexion position, passed over the lateral ligaments, passed under the foot to reach the medial malleolus, and passed across the medial ligaments of the ankle (figure 3), taping was renewed on every alternate day (3 times a week) for 3 weeks. For the corrective footwear, subjects were told to wear properly fitted footwear during the study period- a rubber sole under the heel and the forefoot and a firm heel counter. Those who could not afford the properly fitted footwear were provided with a cushion over the medial arch, which they had to use by placing it in their footwear during their duty hours (figure 4 a & b). Conventional exercises included stretching and strengthening exercises of the foot. Subjects were asked to perform a warm foot bath in the morning and night for 20 minutes, followed by rolling the arch of the foot over a ball back and forth before performing stretching and strengthening exercises. Subjects were instructed to perform stretching exercises while sitting by first crossing the affected leg over the contralateral leg. Then by placing the fingers across the base of the toes (distal to metatarsophalangeal joints), pull the toes back towards the shin until they feel a stretch in the arch of the foot (figure 5). Stretching was also done by pulling both feet inwards using a towel in a long sitting position (figure 6). It was repeated 3 times, holding for 20 seconds twice a day. The strengthening program was focused on the intrinsic muscle of the foot. The exercise used for this is towel curl. To do a towel curl, the patient was instructed to sit with the foot flat on the end of the towel placed on a smooth surface and then to keep the heel on the floor; the towel was then pulled towards the body by curling the towel with toes (figure 7 a & b) and calf raise (figure 8) with 3 sets 10 repetitions twice a day.

Fig 1 & 2: The patient was made to lie prone with the knee extended and ankle in dorsiflexion. Kinesio tape was then attached from the gastrocnemius, progressing towards the Achilles tendon, which after passing the heel, was then cut into four divisions and attached to metatarsals.

Figure 3: This was the second tape attached from the lateral malleolus to the medial malleolus of the foot.

Fig 4a & 4b: A cushion to support the medial arch. It was placed over the medial arch under the well-fitted shoe.

Fig 5 & 6: Self-stretching was taught in two ways. Firstly, they were asked to sit with the affected leg over the contralateral leg. Then by placing the fingers across the base of the toes (distal to metatarsophalangeal joints), pull the toes back towards the shin until they feel a stretch in the foot's arch. Secondly, self-stretching was done by pulling both feet inwards using a towel in a long sitting position using a towel.



7a. 7b.

Fig 7(a) & (b): In the towel curl exercise, the patient was instructed to sit with the foot flat on the towel placed on a smooth surface, keep the heel on the floor, and then pull the towel towards the body by curling the towel with toes.

Fig 8: Calf raises exercise in standing position.

3. DATA ANALYSIS

The analysis was performed using the software called IBM SPSS version 26.0. Statistical tests are mean, standard deviation, paired sample t-test, and independent sample t-test. Paired t-test was performed to see the significant difference in the measures of foot pain through - the numerical pain rating scale (NPRS), foot function index (FFI), and navicular drop test (NDT). The wet test here is not statistically measured as we have done this test only for an observational study to see the arch of the foot.

4. RESULTS

All the subjects (n=30) received treatment sessions for three weeks, where Group- A (Experimental group) received kinesio taping and corrective footwear, and Group- B (Control group) received conventional exercise, which involved self-stretching, towel curls, and calf raise as a treatment protocol.

4.1. Demographic Representation of data

Thirty subjects were evaluated for the study by random sampling method and allocated to Group A(n=15) and Group B(n=15).

Table 1: Demographic Representation of data

	Group A	Group B
Minimum	24.00	24.00
Maximum	37.00	36.00
Age (Mean + SD)	29.80+4.05	28.73 +3.71

In the study, 30 subjects were selected by random sampling method and then allocated to Group A (treated with kinesio taping and corrective footwear) and Group B (conventional exercise). In Group A, the mean age was 29.8 years ranging from 24 to 37 years. Group B's mean age was 28.73 years ranging from 24 to 36 years.

Table 2: Distribution of the patients according to their age

Age	Group A		Group B	
	Frequency	Percent	Frequency	Percent
24 - 29 Years	5	33.3	8	53.3
29 - 34 Years	7	46.7	6	40.0
34 - 39 Years	3	20.0	1	6.7
Total	15	100.0	15	100.0

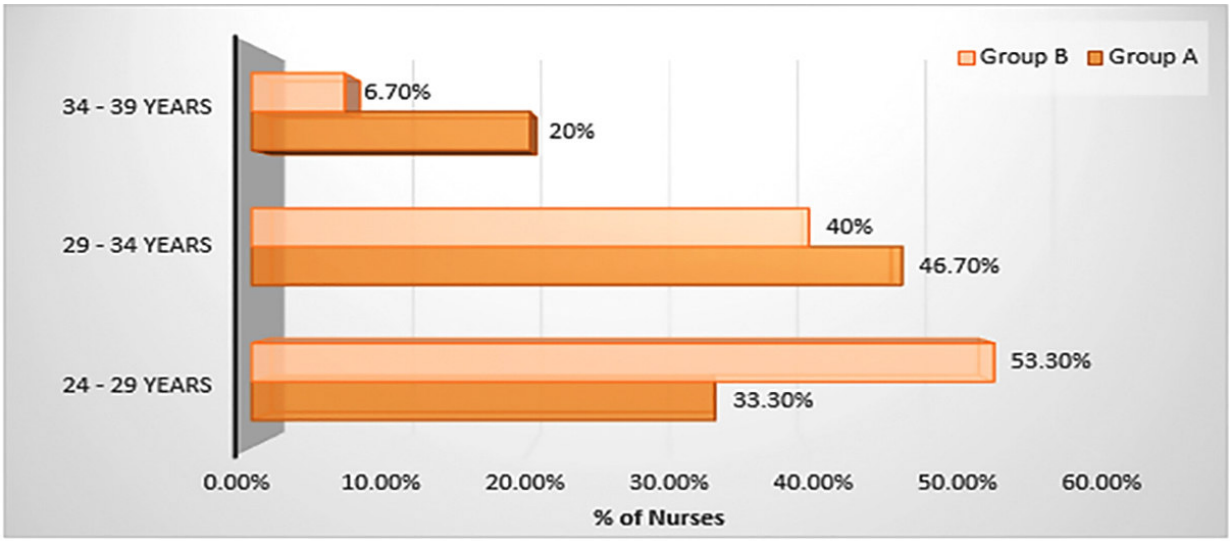


Fig 9: Age distribution of the patients in Group A and Group B

Table3: To find out the combined effectiveness of kinesio taping and corrective footwear for foot pain of ward nurses in GROUP-A

OUTCOME MEASURE		Mean	N	Std. Dev	t	df	p
NPRS	Before Treatment	7.0000	15	.75593	30.882	14	0.00**
	After Treatment	2.2667	15	.79881			
FFI	Before Treatment	47.6667	15	4.38613	40.308	14	0.00**
	After Treatment	13.0000	15	3.81725			
NDT	Before Treatment	7.4667[a]	15	.83381	-----	-----	------
	After Treatment	7.4667[a]	15	.83381			

NS: Not Significant; *: Significant at 5%: **: significant at 1%

- ***Test for Numerical Pain Rating Scale (NPRS)***

It was found that t = 30.882, which is highly significant at a 1% probability level. Furthermore, NPRS decreased remarkably after treating the patients with kinesio taping and corrective footwear. Hence, kinesio taping and corrective footwear effectively improved the foot – the nurses' pain.

- ***Test for Foot Function Index (FFI)***

It was found that t = 40.308, which is highly significant at a 1% probability level (p=0.00). Furthermore, the foot function index decreased remarkably after treating the patients with kinesio taping and corrective footwear. Hence, kinesio taping and corrective footwear effectively improved the foot – pain of the nurses.

- ***Test for Navicular Drop Test (NDT)***

t–test for navicular drop test cannot be performed here because the standard error of the mean difference is zero.

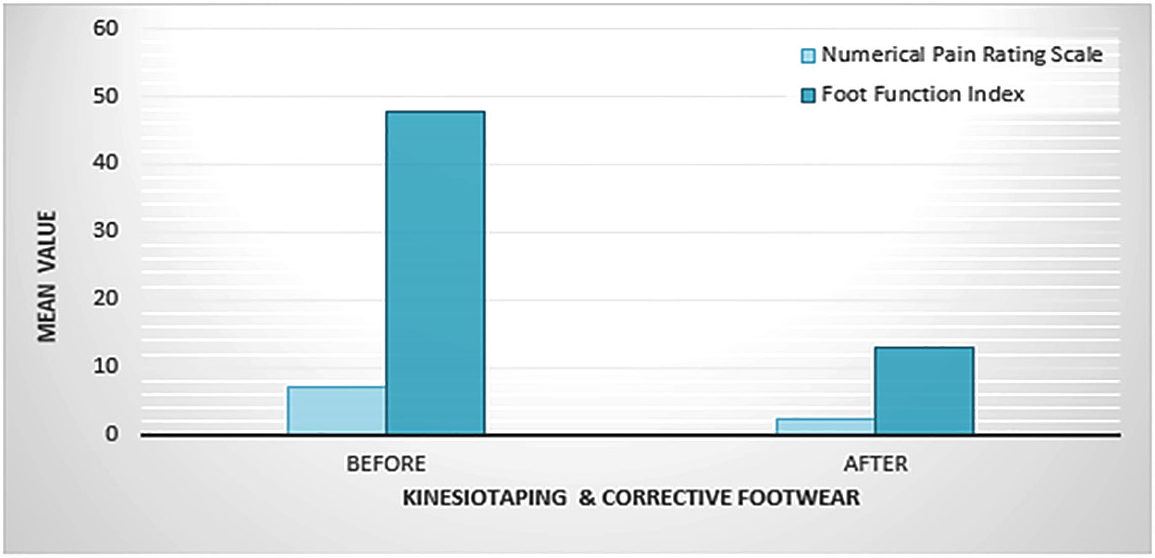


Fig.10: Comparison of foot pain before and after kinesio taping and corrective footwear. The y-axis shows the mean value of the outcome measure before and after treatment, and the x-axis shows the treatment used.

Table 4: To find out the effectiveness of conventional exercise by to reduce foot–the pain of ward nurses

OUTCOME MEASURE		Mean	N	Std. Dev	t	df	p
NPRS	Before Treatment	7.3333	15	1.11270	15.029	14	0.00**
	After Treatment	3.1333	15	.63994			
FFI	Before Treatment	41.6000	15	10.36340	12.227	14	0.00**
	After Treatment	22.0000	15	6.21059			
NDT	Before Treatment	6.6667	15	.72375	1.000	14	0.334 NS
	After Treatment	6.6000	15	.73679			

NS: Not Significant; *: Significant at 5%: **: significant at 1%

- ***Test for Numerical Pain Rating Scale (NPRS)***

It was found that t = 15.029, which is highly significant at a 1% probability level. Furthermore, NPRS decreased remarkably after treating the patients with conventional exercise. Hence, conventional exercise effectively improved the nurses' foot–pain.

- ***Test for Foot Function Index (FFI)***

It was found that t = 12.227, which is highly significant at a 1% probability level (p=0.00). Therefore, the foot function index decreased remarkably after treating the patients with conventional exercise. Hence, conventional exercise effectively improved foot–nurses' pain.

- ***Test for Navicular Drop Test (NDT)***

The calculated value of t = 1.000 is not significant (p=0.334). Hence, we can infer that the navicular drop test was not so effective in reducing the foot pain of the nurses.

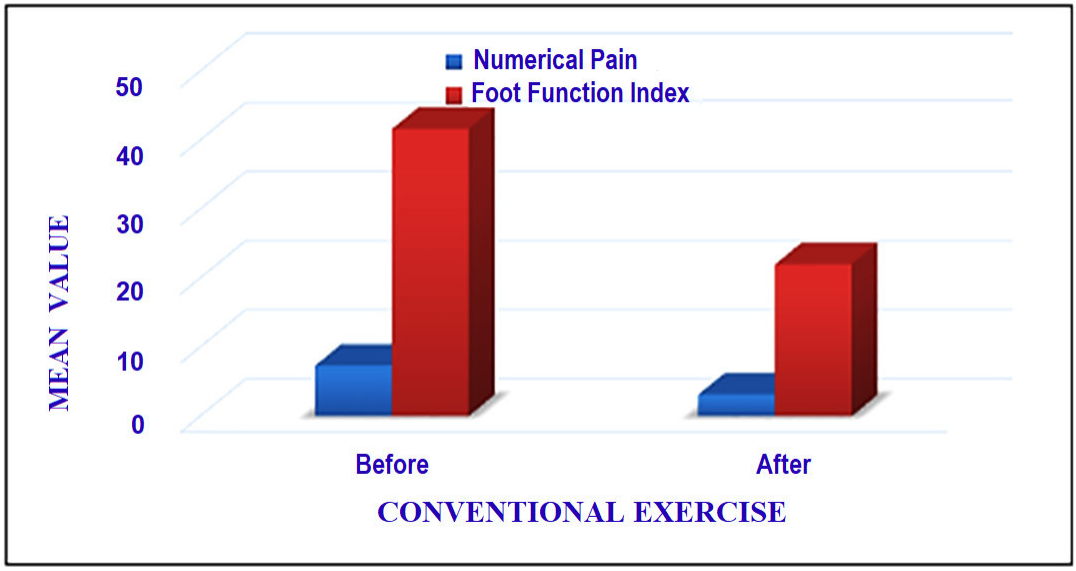


Fig 11: Comparison of foot pain before and after conventional exercise, where the y-axis shows the mean value of the outcome measure before and after treatment, and the x-axis shows the treatment used.

Table 5: To compare foot pain of the ward nurses treated with kinesio taping with corrective footwear and conventional exercise PRE–TREATMENT

Parameters		N	Mean	Std. Dev.	t	df	p
Numerical Pain Rating Scale	Kinesio taping and corrective footwear	15	7.0000	.75593	-.960	28	.345 NS
	Conventional exercise	15	7.3333	1.11270			
Foot Function Index	Kinesio taping and corrective footwear	15	47.6667	4.38613	2.088	28	.046*
	Conventional exercise	15	41.6000	10.36340			
Navicular Drop Test	Kinesio taping and corrective footwear	15	7.4667	.83381	2.806	28	.009**
	Conventional exercise	15	6.6667	.72375			

NS: Not Significant; *: Significant at 5%: **: significant at 1%

The table above compares NPRS, FFI, and NDT of the ward nurses having foot - pain before they were treated with kinesio taping with corrective footwear and conventional exercise. In addition, an Independent t-test was performed to compare NPRS, FFI, and NDT. NPRS of the nurses of both groups was equal before treatment. However, the FFI and NDT of the nurses to be treated with Kinesio taping with corrective footwear were found to be more than the other group.

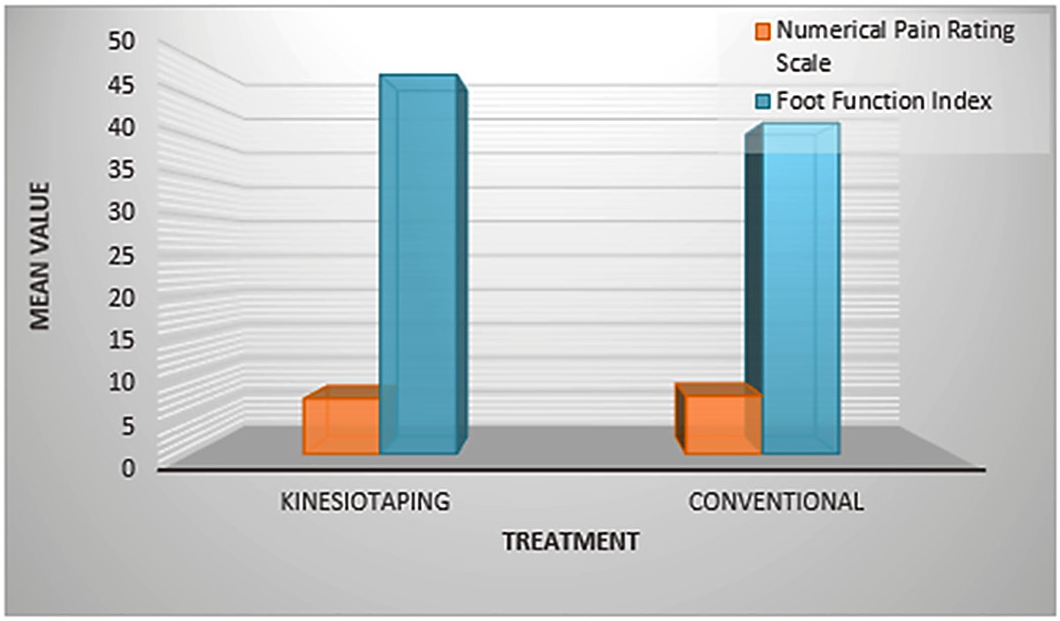


Fig.12: Comparison of foot pain of the patients before treatment, where the y-axis shows the mean value of the outcome measure and the x-axis show the treatment for both group.

Table 6: To compare foot pain of the ward nurses treated with kinesio taping with corrective footwear and conventional exercise POST–TREATMENT

Parameters		N	Mean	Std. Dev.	t	df	p
Numerical Pain Rating Scale	Kinesio taping corrective footwear	15	2.2667	.79881	-3.279	28	.003**
	Conventional exercise	15	3.1333	.63994			
Foot Function Index	Kinesio taping corrective footwear	15	13.0000	3.81725	-4.782	28	.000**
	Conventional exercise	15	22.0000	6.21059			
Navicular Drop Test	Kinesio taping corrective footwear	15	7.4667	.83381	3.017	28	.005**
	Conventional exercise	15	6.6000	.73679			

NS: Not Significant; *: Significant at 5%: **: significant at 1%

The table above compares NPRS, FFI, and NDT of the ward nurses having foot - pain after they were treated with kinesio taping with corrective footwear and conventional exercise. An Independent t-test was performed to compare NPRS, FFI, and NDT. NPRS of the nurses treated with Kinesio taping and corrective footwear was substantially less than those treated with conventional exercise. Likewise, the FFI of the nurses treated with Kinesio taping and corrective footwear was significantly less than those treated with conventional exercise. NDT of the nurses for both groups post-treatment showed minor changes.

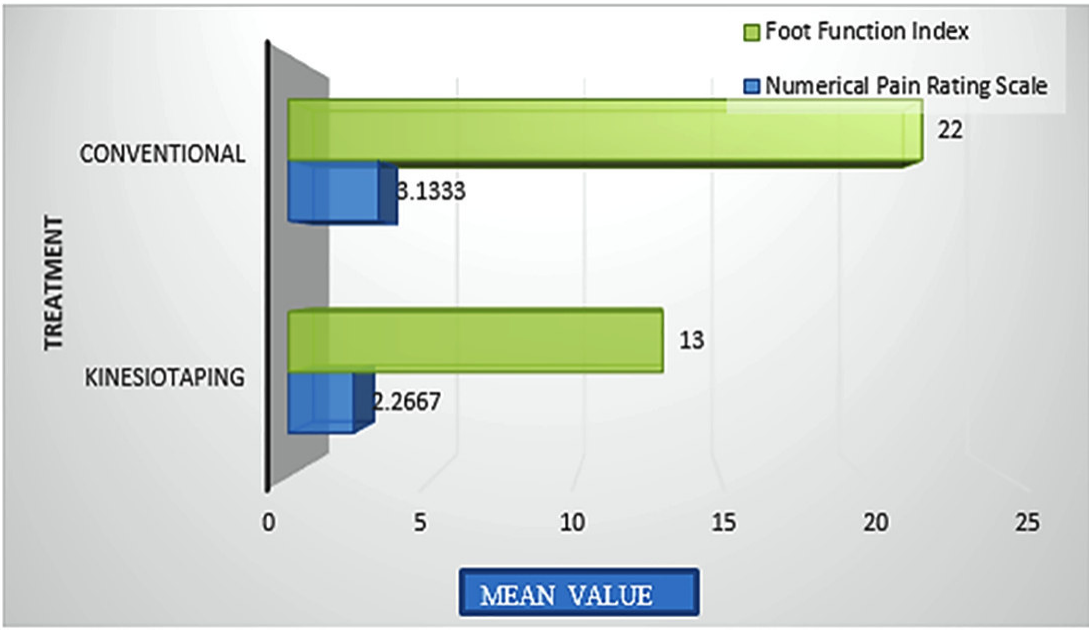


Fig 13: Comparison of foot pain of the patients after treatment, where the x-axis shows the mean value of the outcome measure after treatment, and the y-axis shows the treatment for both groups.

5. DISCUSSION

Foot pain is a common problem in today's generation, leading to discomfort in daily functional activities. One of the most common foot pains is plantar fasciitis – a soft tissue disorder first described by William Wood in 1812[10], which is also a main cause of heel pain[41]. This study's subjects involved only ward nurses because, in a recent study in 2021, Rafael A. Bernardes et al. reported 50% of the nurses with foot/ankle musculoskeletal disorders in the last 12-month period as they are more prone to prolonged standing[42]. This study aimed to determine the combined effectiveness of kinesio taping and corrective footwear among ward nurses with foot pain in an experimental group (GROUP-A) by measuring NPRS, FFI, NDT, and wet test. This study also had a control group (GROUP-B) who received a conventional exercise and was measured by the same parameters. Each group consisted of 15 randomly assigned subjects, and every single subject completed their therapy session. Therefore, no dropouts were recorded. Chiropractor, Dr. KensoKase developed and claimed that "KT not only supports injured muscles and joints but also helps to relieve pain by lifting the skin by allowing improved blood and lymph flow" [43]. Wang et al., in the year 2010, showed that KT had an immediate positive effect on flexible flat feet by reducing increased foot pressure, improving tone, and reducing stiffness in the muscles[44]. Chien-Tsung Tsai et al. 2019 performed a study to investigate the therapeutic effect of kinesio taping in plantar fasciitis within two groups, one with KT and the other with no taping, and found that the pain score decreased sigificantly[45]. Ill-fitting footwear can be big, which makes it loose, or too small, which makes it, and also increases foot pain and decrease stability[46,33]. Footwear fitting is very important as, in most cases, fit means function[46]. As Kolarik (1995) states, 'I... a customer may demand shoes that fit right (a "true" quality characteristic). The customer will judge their shoe fit by wearing the shoes...' which means that the quantification of fit depends upon the prediction of discomfort and pain[47]. Longitudinal arch supports are intended to prevent depression of the subtalar joint and flattening of the arch. A resilient scaphoid pad positioned at the medial border

of the insole with the apex between the sustentaculumtali and the navicular tuberosity [34pg1328]. In this study, participants of both the group – experimental group (GROUP-A) with kinesio taping and corrective footwear and the control group (GROUP-B) with conventional exercises have shown improvement in pain and functional outcome. But the mean NPRS in group A decreased from 7.00 to 2.26, and in group B from 7.33 to 3.11, mean FFI in group A decreased from 47.66 to 13.00 and for group B from 41.60 to 22.00, which showed that NPRS and FFI test was highly significant ($p<0.01$). Mean NDT in group A was 7.33 to 7.4, and in group B it was 6.66 to 6.60, which showed that NDT is significant at a 1% probability level ($p=.005< 0.01$), as the mean score remained the same pre and post-treatment. Therefore, through this measure, we can state that the treatment protocol for group A significantly improved in reducing pain. Still, the navicular drop test did not reduce foot pain or any foot pronation for the nurses.

6. CONCLUSION

Both the groups - Group A (kinesio taping and corrective footwear) and Group B (conventional exercises) have shown some improvement in post-treatment based on the mean score. Still, we have noted that NPRS and FFI in group A decreased from 7.00 to 2.26 and 47.66 to 13.00, which showed that the test was highly significant ($p<0.01$). Therefore, Group-A, treated with kinesio taping and corrective footwear, showed better improvement regarding pain relief and functional outcome than Group B, treated with conventional exercise, maybe due to the physiological effect of kinesio tape and support provided by corrected footwear. Hence, it is concluded that the intervention used in Group A (kinesio taping and corrective footwear) was more effective in reducing pain among the ward nurses than in Group B (conventional exercise). But, as our study was of short duration with no follow-up, we couldn't find any biomechanical changes in the foot; therefore, increasing the duration of the treatment and follow-up is recommended for better results.

7. AUTHORS CONTRIBUTION STATEMENT

Nirpana Gurung, MPT Scholar, carried out the research work in data collection and literature review and prepared the thesis as a part of the curriculum of Masters in Physiotherapy. Dr. Abhijit Dutta (PT) (Corresponding Author), Associate Professor, Associate Dean, Faculty of Paramedical Sciences, Assam Down Town University, guided as the main study's main supervisor along with methodology, result analysis, and discussion of the study. Dr. Shalaka Bhattacharyya, Assistant Professor, Department of Physiotherapy, helped review the literature and the methodology of the research work. Finally, all the authors read and approved the final version of the manuscript.

8. LIMITATION

The sample study was small (Group A, n = 15; Group B, n = 15); this study consisted of a short course of treatment (3 weeks), there were no biomechanical changes as the treatment period was only 3 weeks, and no long term follow up for the patients.

9. CONFLICT OF INTEREST

Conflict of interest declared none.

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