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Original Research

The Effect of Textured Insole and Taping on Job Performance and Work Ethic in Physical Education Teachers with Non-specific Chronic Low Back Pain

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ABSTRACT

The aim of this study was to investigate the effect of textured insole and taping on job performance and work ethic in physical education teachers with non-specific chronic low back pain. The present study was a quasi-experimental study with a pretest-posttest design. The statistical population included physical education teachers with chronic nonspecific back pain in Tehran. The statistical sample included 36 patients with non-specific chronic low back pain who were divided into three groups: textured insole (n = 12), taping (n = 12) and control (n = 12). According to the coordination with physical education teachers, two questionnaires of Patterson (1990) and Gregory (1990) Job Performance Questionnaire were given to physical education teachers with non-specific chronic back pain and they were asked to answer the questions patiently and carefully. After collecting the questionnaires, the subjects of experimental groups were divided into two groups of taping and textured insoles. The subjects used textured insole and taping for 4 weeks and immediately the questionnaire of job performance and work ethic was given to the subjects again and after completing the questionnaires, it was collected by the researcher. Two-way analysis of variance was used for statistical analysis. The results showed that 4 weeks of taping and textured insole in physical education teachers with non-specific chronic back pain had a significant effect on work ethic and job performance ($p<0.05$). According to the research results, it can be concluded that taping and textured insoles have a positive effect on work ethic and job performance of physical education teachers with chronic non-specific low back pain.

Keywords: Textured Insole, Taping, Job Performance, Work Ethic, Low Back Pain

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INTRODUCTION

About 80 percent of the population suffers from a bout of low back pain at some point in their life. However, some people are at higher risk for chronic and acute back injuries due to their lifestyle (1). The cause of most low-back pain is related to muscle or ligament strain. The pain usually resolves with rest, physical therapy and athletic training services (2). If low-back pain is accompanied by pain that radiates down the legs and numbness or weakness in the foot or ankle, the culprit may be a disk problem. For obvious reasons, athletes are at greater risk of sustaining a lumbar [lower] spine injury due to physical activity (1). Whether the sport is skiing, basketball, football, ice skating, soccer, running, golf, or tennis, the spine undergoes a lot of stress, absorption of pressure, twisting, turning, and even bodily impact. This strenuous activity puts a strain on the back that can cause injury to even the finest and most fit athletes. Though the entire spine is used when playing sports, it is estimated that 5-10 percent of all athletic injuries are related to the lumbar [lower] spine (3-5). Many cases of low back pain in athletes can be traced to a specific event or trauma; others are brought about by repetitive minor injuries that result in micro traumas (6). Even though low back pain can often be treated without major disruption in a person's life, athletes are often reluctant to seek medical help. Many of them deny or minimize complaints in order to avoid consequences, such as: having to decrease activity in order to recover, losing a position or being removed from a team, missing a competition, or letting the team down. Others fear they might lose their worth to the team. Some athletes simply do not want to bother seeing a doctor for pain; they believe it will recover on its own (7). Therefore, many athletes buck up their strength, pop some over-the-counter pain medication, and tolerate the pain for the sake of the game and personal enjoyment. However, avoiding medical help can lead to further and more serious injury. In some cases, without medical help the anatomic damage could eventually lead to permanent exclusion from sporting activities. This can negatively affect the work ethic of the athlete (8). Work ethic is a belief that hard work and diligence have a moral benefit and an inherent ability, virtue or value to strengthen character and individual abilities (9). It is a set of values centered on importance of work and manifested by determination or desire to work hard. Social ingrainment of this value is considered to enhance character through hard work that is respective to an individual's field of work (10). Proponents of a strong work ethic consider it to be vital for achieving goals, that it gives strength to their orientation and the right mindset. A work ethic is a set of moral principles a person uses in their job. People who possess a strong work ethic embody certain principles that guide their work behaviour; to develop and process a strong work ethic will inevitably result in the production of high-quality work which is consistent. The output motivates them to stay on track (11). Moore (2017) compared work ethics in athletes and non-athletes. The results showed that athletes had more work ethics than non-athletes (12). Timco (2010) also suggested that a better understanding of physical activity, such as athletic participation and its relationship with work ethic, is needed (13). When athletes, referees, coaches, or administrators attempt to circumvent the rules of the game, they undermine the foundations of sport itself. The value of sports lies in their ability to do more than identify the best athletes. Sports can instill important values, including respect and teamwork, as well as teach lessons about perseverance and honesty. As far back as ancient Greece, athletics have been seen as an important character-building tool that encourages discipline, collaboration, and responsibility. Sports without work ethics do not live up to these values (14).

Job performance assesses whether a person performs a job well (15). Job performance, studied academically as part of industrial and organizational psychology, also forms a part of human resources management. Performance is an important criterion for organizational outcomes and success (16). John P. Campbell describes job performance as an individual-level variable, or something a single person does (15). This differentiates it from more encompassing constructs such as organizational performance or national performance, which are higher-level variables (16). Health benefits from physical exercise are the standard reason for individuals to begin and continue exercising on a regular basis. What individuals might not know is that recently studies have been conducted to show that physical exercise has in fact been proven to increase mood and increase job performance (17). Many psychologists and top companies have incorporated physical exercise into the corporate strategy to help increase mood and job performance which results in more productive employees (18). Individuals today have many options to choose from as to what form of physical exercise they wish to engage in. Anything from the gym (lifting weights) to sports (tennis, basketball, swimming, etc.) to going for a run outside (17).

Today, researchers use a variety of treatments to treat low back pain patients (19-22). One of these treatments is the use of taping. The use of taping according to the type of exercise and the needs of athletes has an important role in preventing injuries caused by exercise and supporting the limbs (23). The physiological basis of taping methods has been that skin taping stimulates mechanical skin receptors, thus increasing the input of sensory data from the environment to the central nervous system, and this increase in sensory input itself improves deep sensation and muscle function (23). Many studies have used different types of taping to prevent injury and reduce pain, but recently different taping methods have been used to improve muscle function. It is likely that the ground reaction force at the end of the chain, between the foot and the ground, will also be affected by taping on the sense of depth (24). It's thin, elastic material provides safe, comfortable support without restricting range of motion and each application can be worn lymphatic systems to reduce swelling and bring pain relief to injured or overused muscles and joints. For the experienced taping professional, strips of tape can be easily cut from a roll and applied in various formations. However, precut kinesiology tape applications can make the process a breeze for even novice tapers. Here are some recommendations for products and resources to help you get started with kinesiology taping for back pain (25).

The foot is the first point of contact between the body and the external environment, and it plays an important role in postural sway (26). Its plantar mechanical receptors provide spatial and temporal information about contact pressures and shear forces resulting from body movement being a valuable feedback mechanism to the postural control system. Interventions to optimize sensory information from plantar pressure as vibration stimuli (27), custom foot orthoses (28), textured insoles (29), and shoe with textured insoles18,19 and magnetic insoles have been tested before, some of them showing balance improvement (27). Textured insoles are simple interventions that could be a low-cost adjuvant intervention to improve balance in the elderly, without the need of podiatric assistance (30). There are just a few studies in this field, most of them with small number of patients and assessment of postural control soon after intervention. While balance improvement was observed with surface edge elevations, rounded plastic nubs (29), granulations and sandals equipped with spike insoles no difference was described with textured insoles in other studies. Insoles have been used for many years. They make the person feel more comfortable (31). This phenomenon is achieved by decrease in the point pressure by 30–50% (depends on the material the insole is made of) (32). It was also proven by electromyography studies that insoles decrease the fatigability in the back muscles (33, 34).

Not many studies have looked into the agronomic physiological aspects of insoles (35). Brown and co-workers concluded that more research is needed to explain the clinical success in using insoles (36). The most common method for foot pressure distribution by shoe-insoles is to increase the contact area between the foot and the insole surface (37). This can be achieved by custom-molding the shoe insole to accommodate differences in foot shape (38). Semi-customization is also possible using an insole surface material that gradually adapts to the foot's shape. Foot center of pressure (Cop) trajectory in a normal gait starts at the heel and ends at the toe, with a lateral curvature (39). This lateral excursion seems to be a reflection of ankle supination during mid-stance. As indicated above, balance control is determined by the relationship between center of mass (Com) and base of support (Bos). A specially designed insole can control the Cop which changes Com motion and it is particularly important to regulate excessive lateral Cop excursion to stabilize sideways balance (40). A potential solution is an insole incorporating enhanced texture to consistently guide the optimal Cop path. The aim of this study was to investigate the effect of textured insole and taping on job performance and work ethic in physical education teachers with non-specific chronic low back pain.

METHODOLOGY

Samples and data preparation

The present study was a quasi-experimental study with a pretest-posttest design. The statistical population included physical education teachers living in Tehran in 2020 who were simultaneously active in different sports and complained of chronic non-specific low back pain. The statistical sample consisted of 36 physical education teachers with non-specific chronic low back pain who were randomly selected. A priori power two-way analysis of variance software (G*3 Power) revealed that for a statistical power of 0.80 at an effect size of 0.80 and with an alpha level of 0.05 a sample size of at least 36 participants were required (41). Non-specific chronic low back pain was identified by a physician. Samples were divided into three groups of 12

people textured insole, taping and control. Inclusion criteria included having chronic back pain; not having surgical history [knee, spine, hip and ankle] and age range 24 to 35 years. Exclusion criteria included: history of skeletal muscle dysfunction, history of arthritis, chronic arthritis infection or bone disease, ligament injury, ligament remodeling, and muscle disorders.

According to the coordination with the athletes, first two questionnaires of job performance and work ethic were given to athletes with back pain and they were asked to answer the questions patiently and accurately. After collecting the questionnaires, the subjects in experimental groups were divided into two groups of taping and textured insoles. The subjects used textured insole and taping for 4 weeks and immediately the questionnaire of job performance and work ethic was given to the subjects again and after completing the questionnaires, it was collected by the researcher.

Textured FOs

The insole used in the present study are made in American (Lp Support Insoles Silicone 321) which was used for 4 weeks for 12 people. Subjects were told to use this type of insole for any daily activity (Figure 1).

Fig 1. Lp Support Insoles Silicone 321

Taping

The tapea used in this study was waterproof, porous, and adhesive, with a width of 5 cm and thickness of 0.5 mm. The experimental group received a standardised Kinesio Tape application in sitting position. Four blue I-strips were placed at 25% tension overlapping in a star shape over the point of maximum pain in the lumbar area. Strips were applied by pressing and adhering the central part before the ends [Figure 2]. Participants in both groups were advised to leave the tape in situ for 4 weeks. The taping was replaced by the researcher every 3 days. The practitioner applying the tape was careful to ensure that the rest of the treatment consultation was exactly the same for both groups.

Fig 2. Taping

Work Ethics and job performance

The Work Ethics Questionnaire was developed by Gregory C. C. Petty in 1990. The four dimensions of work ethic according to Petty (1990) are: attachment and interest in work, perseverance and seriousness in work, healthy and humane relationships in the workplace, collective spirit and participation in work and includes 23 items. This questionnaire is based on the Likert scale (strongly disagree, 1; disagree, 2; neither agree nor disagree, 3; agree, 4; strongly agree, 5). Gregory reported 76% and 85% reliability and validity of the Work Ethics Questionnaire, respectively. The reliability of this questionnaire was obtained by (Golparvar and Nadi, 2011) with Cronbach's alpha test of 0.85.

This study also utilized 5-items instrument by Paterson, Neyman, Kinney & Farr (1990) for job performance (7 questions). All instruments were measured using 6-point Likert scale (1 = strongly disagree, disagree, natural, agree and 6 = strongly agree). Paterson, Neyman, Kinney & Farr (1990) reported 74% and 80% reliability and validity of the Job Performance Questionnaire, respectively.

Statistical analyses

Firstly, the normality of the variable distributions was verified using shapiro-wilk test. Two-way analysis of variance test was used for within group comparisons. The significance level was set at $p < 0.05$ for all analyses. Statistical analyses were performed using SPSS [version 24, SPSS Inc, 8 Chicago, IL]. Additionally, the effect size was calculated as a ratio of mean difference divided by the pooled standard deviation.

RESULTS

The anthropometric parameters of individuals are given in Table 1. There was no significant difference in the anthropometric parameters of individuals between two groups of insole and taping.

Table 1. Demographic characteristics

	Insole	Taping	Sig
N	12	12	NA
Age [year]	26.76±4.30	27.41±5.24	0.795
Mass [kg]	74.70±15.47	76.70±13.56	0.845
Height [cm]	170.8±22.84	171.05±26.81	0.543
BMI	23.19±5.85	24.80±6.61	0.699

Note: Values are mean ± standard deviation. Abbreviations: n, number of participants; BMI, body Index. * Significance level $p< 0.05$.

The anthropometric parameters of individuals are given in Table 2. There was no significant difference in the anthropometric parameters of individuals between two groups of insole and control.

Table 2. Demographic characteristics

	Insole	Control	Sig
N	12	12	NA
Age [year]	26.76±4.30	25.89±6.52	0.638
Mass [kg]	74.70±15.47	75.12±10.79	0.432
Height [cm]	170.8±22.84	171.98±30.58	0.705
BMI	23.19±5.85	25.23±4.08	0.362

Note: Values are mean ± standard deviation. Abbreviations: n, number of participants; BMI, body Index. * Significance level $p< 0.05$.

The anthropometric parameters of individuals are given in Table 3. There was no significant difference in the anthropometric parameters of individuals between two groups of taping and control.

Table 3. Demographic characteristics

	Taping	Control	Sig
N	12	12	NA
Age [year]	27.41±5.24	25.89±6.52	0.795
Mass [kg]	76.70±13.56	75.12±10.79	0.845

Height [cm]	171.05±26.81	171.98±30.58	0.543
BMI	24.80±6.61	25.23±4.08	0.699

Note: Values are mean ± standard deviation. Abbreviations: n, number of participants; BMI, body Index. * Significance level $p < 0.05$.

Comparison of the findings showed that in all variables, there was no statistically significant difference between the insole and taping groups during the pre-test ($p>0.05$) (Table 4).

Table 4. Comparison of Work Ethics and job performance between the insole and taping groups during pre-test.

Value	Insole	taping	p
Work Ethics	24.52±6.12	25.75±5.32	0.567
job performance	15.23±4.25	15.95±4.33	0.735

Comparison of the findings showed that in all variables, there was no statistically significant difference between the insole and control groups during the pre-test ($p>0.05$) (Table 5).

Table 5. Comparison of Work Ethics and job performance between the insole and control groups during pre-test.

Value	Insole	Control	p
Work Ethics	24.52±6.12	23.10±8.56	0.214
job performance	15.23±4.25	16.54±4.36	0.365

Comparison of the findings showed that in all variables, there was no statistically significant difference between the taping and control groups during the pre-test ($p>0.05$) (Table 6).

Table 6. Comparison of Work Ethics and job performance between the taping and control groups during pre-test.

Value	Taping	Control	p
Work Ethics	25.75±5.32	23.10±8.56	0.745
job performance	15.95±4.33	16.54±4.36	0.436

Statistical analysis demonstrated significant main effect of "Time" for work ethic ($p=0.021$) and job performance ($p=0.003$) (Table7). Statistical analysis demonstrated significant main effect of "group" for work ethic ($p=0.014$) (Table7). Statistical analysis demonstrated significant main effect of "group*time" interaction for work ethic and job performance ($p<0.017$) (Table7). Post hoc analysis demonstrated in insole group significant increases was observed from pre- to post-test for Work Ethics ($p=0.002$) and job performance ($p=0.004$) (Table7). Also, Post hoc analysis demonstrated in taping group significant increases was observed from pre- to post-test for Work Ethics ($p=0.007$) and job performance ($p=0.023$) (Table7). In addition, Post hoc analysis demonstrated in control group no significant difference was observed from pre- to post-test for Work Ethics and job performance ($p>0.05$) (Table7).

Table 7. Comparison of work ethic and job performance in three groups of textured insole and taping

value	insole		p	taping		p	control		p	Effect time	Effect group	Effect group*time
	Pre	Post		pre	post		pre	post				
Work Ethics	24.52±6.12	23.42±3.56	0.003	25.75±5.32	26.40±6.36	0.007	23.10±8.56	17.00±6.23	0.325	0.021 [0.356]	0.004 [0.426]	0.016 [0.521]
job performance	15.23±4.25	24.89±6.68	0.014	15.95±4.33	22.32±7.55	0.023	16.54±4.36	15.20±6.35	0.524	0.002 [0.563]	0.563 [0.456]	0.001 [0.736]

* Significance level p< 0.05.

DISCUSSION

Back pain is one of the most common diseases in this century. Most athletes suffer from back pain while exercising. Athletes are very willing to participate in competitions under any circumstances, and this unfortunately sometimes causes athletes to refuse to see a doctor. This can affect the quality of work life and consequently the job performance and work ethic of athletes and cause negative performance in training and competitions. The use of textured insoles and taping in this study has led to a positive effect on back pain and a positive feeling in these people and increased job performance and work ethic in athletes. The aim of this study was to investigate the effect of textured insole and taping on job performance and work ethic in athletes with low back pain.

The results showed that a period of using textured insole has improved work ethic and job performance. The relation between insoles, feet pain and low back pain was examined mainly on athletes (42) and on people whose their job involves a lot of standing (34). In the latter, it was found that 74% of the examinees found the insoles to be comfortable and reported decrease in their feet and lower back pain (31). The fact that the insoles reduced the low back pain rate proves its potential to absorb some of the force, which is generated by repetitive walking. Windle and co-workers have shown that the insoles placed in shoes would attenuate the peak pressure at heel strike during running and marching compared to a “no insole” condition (43). A decrease in the shock-wave amplitude transferred to the tibia in subjects who had insoles was reported by Light et al. (44). This decreased load, which in turn transfers less energy towards the upper part of the lower extremity and the lumbar spine. According to past research, people leave their jobs or sports due to low back pain or go on long leave. On the other hand, these people always refer to work with complaints of back pain, which can reduce the services to clients. It seems that the textured insole with the proposed mechanisms has been able to minimize the rate of back pain complaints in these people and increase job performance and work ethic in these people.

Also, the results showed that a period of using taping has improved work ethic and job performance.

The precise mechanisms underlying the effect of Kinesio Taping on job performance and work ethic are not yet clear. Some authors have hypothesised that pain is relieved by Kinesio Taping because sensory modalities operate within interconnecting, intermodal and cross-modal networks (45). Others have suggested that keratinocytes may be non-neural primary transducers of mechanical stimuli, probably via a signal transduction cascade mechanism [eg, intracellular Ca2+ fluxes] to evoke a response on adjacent C-fibres

(46). Another hypothesis is that the cutaneous stretch stimulation provided by Kinesio Taping may interfere with the transmission of mechanical and painful stimuli, delivering afferent stimuli that facilitate pain inhibitory mechanisms [gate control theory] and pain reduction (20). A further possible mechanism by which Kinesio Taping induced these changes may be related to the neural feedback received by the participants, which may improve their ability to reduce the mechanical irritation of soft tissues when moving the lumbar spine (19). Furthermore, Kase and colleagues (47) proposed a theoretical framework to explain the decrease in lumbar pain-associated disability observed immediately after Kinesio Taping. They argued that when a muscle is hypertonic, it stimulates Golgi receptors to transmit information to the central nervous system, where inhibitory motor neurons are activated, and that Kinesio Taping application would act by stimulating Golgi receptors to initiate this process. It seems to be one of the main reasons for increasing job performance and work ethic after using textured insoles and taping the same mechanisms. Low back pain has reduced the useful performance of people in the workplace and they often miss work due to complaints of back pain (47). Decreased productivity and absenteeism are at odds with work ethic and job performance. It seems that any factor that improves low back pain can probably lead to improved job performance and work ethic.

CONCLUSION

The results showed that 4 weeks of taping and textured insole in physical education teachers with non-specific chronic back pain had a significant effect on work ethic and job performance. According to the research results, it can be concluded that taping and textured insoles have a positive effect on work ethic and job performance of physical education teachers with chronic non-specific low back pain.

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چکیده فارسی

اثر تیپینگ و کفی بافت دار بر عملکرد شغلی و اخلاق کاری در معلمان تربیت بدنی دارای کمر درد مزمن غیراختصاصی

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هدف از این مطالعه بررسی اثر تیپینگ و کفی بافت دار بر عملکرد شغلی و اخلاق کاری در معلمان تربیت بدنی دارای کمر درد مزمن غیراختصاصی بود. مطالعه حاضر یک مطالعه نیمه تجربی با طرح پیش آزمون- پس آزمون بود. جامعه آماری شامل معلمان تربیت بدنی دارای کمر درد مزمن غیراختصاصی در تهران بودند. نمونه آماری شامل ۳۶ نفر بیمار کمر درد مزمن غیر اختصاصی که به سه گروه کفی بافت دار (۱۲ نفر)، تیپینگ (۱۲ نفر) و کنترل تقسیم شدند. با توجه به هماهنگی انجام شده با ورزشکاران، ابتدا دو پرسشنامه عملکرد شغلی پترسون (۱۹۹۰) و اخلاق کار گرگوری (۱۹۹۰) به معلمان تربیت بدنی دارای کمر درد مزمن غیر اختصاصی داده شد و از آنها خواسته شد تا با صبر و دقت به سوالات پاسخ دهند. آزمودنی ها به مدت ۴ هفته از کفی بافتی و تیپینگ استفاده کردند و بلافاصله پرسشنامه عملکرد شغلی و اخلاق کاری مجدداً به افراد داده شد و پس از تکمیل پرسشنامه ها توسط محقق جمع آوری شد. از آزمون آنالیز واریانس دو سویه برای تجزیه و تحلیل آماری استفاده شد. نتایج نشان داد ۴ هفته تیپینگ و کفی بافت دار در معلمان تربیت بدنی دارای کمر درد مزمن غیر اختصاصی بر اخلاق کاری و عملکرد شغلی تاثیر معنی داری داشتند ($p<۰/۰۵$). با توجه به نتایج پژوهش می‌توان نتیجه گرفت تیپینگ و کفی بافت دار اثر مثبتی بر اخلاق کار و عملکر د شغلی معلمان تربیت بدنی دارارای کمر درد مزمن غیر اختصاصی دارد.

واژه های کلیدی: کفی بافت دار، تیپینگ، عملکرد شغلی، اخلاق کاری، کمر درد