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Original Article

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Volume 8 Number 2, April - June 2015

Association of Manual Examination with Radiological Examination in Assessment of Lumbar Intervertebral Mobility in Asymptomatic Subjects: A Cross-Sectional Study

Nisha Rani Jamwal*, Senthil P. Kumar**

Abstract

Background and purpose: Clinical examination of lumbar intervertebral mobility (LIVM) involves manual application of force on lumbar spinous processes to localize the symptoms while radiological examination involved functional (flexion-neutral-extension) radiography. The objective of this study was to evaluate the concurrent (criterion-related) validity of central postero-anterior (PA) pressure when compared to functional radiography in assessment of LIVM in asymptomatic participants. *Materials and methods:* Assessor-blinded cross-sectional study with random-order repeated-measures design was performed on 48 consented asymptomatic adult participants of either gender (34 male, 14 female), with mean age 23.6 ± 4.8 years. Central PA pressure assessment was done and graded using the seven-point joint play grading scale of Stanley Paris (0- ankylosed, 6- unstable) while functional radiography and manual tracing were done to measure intersegmental anterior and / or posterior rotations and / or translations. Karl-Pearson's correlation co-efficient was used for analysis in SPSS version 11.5 for Windows. *Results:* It is evident that there was a comparable change in the segmental mobility measured using manual and radiological examination in all the subjects studied. This finding is specifically noted between the JPGS with posterior rotation and anterior translation. E.g., a normal mobility on JPGS at L1 was seen with normal anterior translation and posterior rotation values from X-ray but not in posterior translation and anterior rotation. *Conclusion:* The study showed that manual examination of intervertebral mobility using central PA pressure was comparable to the radiological assessment of intersegmental mobility of the spine in the five subjects studied. This significant correlation was noted especially for the anterior translation and posterior rotation radiological measurements with the manual assessment using the central PA pressure. The joint play grading scale was a useful clinical tool to measure and record intervertebral mobility in the normal subjects studied.

Keywords: Physical Examination; Concurrent Validity; Lumbar Spine Mobility; Manual Therapy.

Introduction

Low back pain remains a very common condition that affects an estimated 80% of adults with recurrence rates ranging from 60-85% during some period in their life [1]. Low back pain ranks second only to common cold as a reason for the patient to visit a physician, and the leading cause for a visit to a physical therapist. Low back pain was shown to be associated with recurrence and long-term disability if not properly detected and managed during the first episode of onset. To avoid recurrence and to prevent the potential complications, clinicians should be able to identify the exact source of pain as either syndromes or as mechanisms [1]. However, Spratt et al estimated that a precise diagnosis is unknown in 80 -90% of disabling low back disorders [1].

The lumbar spine is anatomically identified as the region involved in MLBP due to poor sitting/ standing posture, abnormal stresses in the form of micro or macro trauma during regular and / or work-related activity [1]. Altered function of the spinal segment during postures and / or movements is defined as a spinal dysfunction. Vertebral dysfunctions can either be at single or multiple spinal levels of hypo / hyper- mobility. Various sophisticated assessment methods to detect spinal

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segmental motion are available but they are not cost-effective. Clinical examination thus remains as a gold standard next to surgery for diagnosis in MLBP.

For a better clinical diagnosis, subjective and objective examination findings obtained during physical examination findings of the patient are often correlated with laboratory and radiological findings. Although various clinical methods of lumbar spine examination exist, manual examination comprising of passive physiological intervertebral mobility (PPIVM) testing and passive accessory intervertebral mobility (PAIVM) testing was anecdotally recommended for localizing the dysfunctional spinal level in patients with mechanical low back pain (MLBP).

Postero-anterior mobilization is a commonly used technique among physical therapists to diagnose and treat MLBP patients [4]. During this technique, the tester applies vertically directed force (downwards to the plinth) on lumbar spinous processes to assess mobility and pain response amongst patients with MLBP [4]. Patients with non- specific low back pain (NSLBP) or MLBP commonly demonstrate a symptom-specific pain response and / or increased resistance of the dysfunctional lumbar spinal level during PA technique, thus mastering the PA technique is important for clinical judgment and treatment [7].

Functional Radiography can demonstrate abnormal motion between two vertebrae using dynamic plain radiographs obtained in both flexion and extension and it proves to be a simple and reliable method to determine motion segment instability and can also indicate the lesions located in specific areas based on the ''dominant lesion'' concept. The location of the dominant lesion determines the pattern of instability. If the dominant lesion is anterior primary restraint failure, there is excessive posterior horizontal translation in the extension views. If the dominant lesion is primary posterior restraint failure one should find anterior horizontal displacement in the flexion view and radiologically detectable abnormal patterns of coupling in the posterior elements [8]. Flexion-extension views can detect four types of segmental instability: forward translation of one vertebra over the other - anterior sliding instability; backward translation - posterior sliding instability; excessive angular movement of a motion segment / rotation - angular instability; and, abnormal axial rotation in which posterior margin of the vertebral body has a focal double contour during bending.

The purpose of this study was to correlate the manual examination of lumbar PAIVM (assessed manually using the central PA pressure) with radiological method (using flexion- extension radiograph of the lumbar spine), at the lumbar spinal levels L_1 to L_5 in asymptomatic participants.

Materials and Methods

Ethical clearance

The study protocol was approved by the Institutional ethics committee of Kasturba Medical College (Manipal University), Mangalore. All participants were required to provide a written informed consent prior to their screening and participation in the study.

Study design:

Cross-sectional study, with random-order repeated-measures design.

Study setting

Out-patient treatment setting in a multispecialty university-affiliated teaching hospital.

Study location

Dept of Physiotherapy Kasturba Medical College (Manipal University), Mangalore.

Sampling

Convenient sampling

Subjects

Asymptomatic participants were recruited upon providing one-one verbal information from staff, students and patient caregivers in Kasturba Medical College Hospital, Mangalore.

Participant selection

The participants were selected based upon the following inclusion criteria: age between 18-45 years; no history of low back pain; nor previous trauma or surgery to lumbar spine; no previous medical illnesses in 6 months; and ability to provide consent. Those who had obesity, pregnancy or pain / discomfort during manual examination were excluded.

Tester I: Selected subjects were evaluated by a qualified physiotherapist who was a lecturer in

Musculoskeletal and manual therapy. He performed the manual assessment of intervertebral mobility using the central Postero Anterior pressure. He was blinded from the clinical and the radiological findings of the subjects found by the other testers.

Tester II: Performed the screening physical examination of the lumbar spine, was a student physiotherapist, who was blinded from the study.

Tester III: Performed the functional radiographs of the lumbar spine, who was an X- ray technician, was blinded from the study.

Tester IV: Performed the radiological measurement of lumbar intervertebral mobility using the flexion-extension radiographs, who was a qualified physiotherapist, was blinded from the study.

Testing instruments

- Joint play grading scale
- Standard X- ray equipment
- Screening checklist (see appendix)
- Marker to indicate spinous processes of lumbar spine
- Cotton and spirit to erase the markings on the skin
- Plinth
- Pillow
- Ruler
- Goniometer
- Inch tape

Procedure

Each subject served as their own controls. The order of procedure- manual and radiological examination were randomly assigned to each subject that is some subjects received manual examination first and then radiological whereas others vice versa.

Tester II did the screening examination of all the subjects according to the lumbar spine screening and evaluation form shown in appendix.

Tester I did the manual examination of the intervertebral mobility using the central postero anterior pressure.

The functional radiographs of the lumbar spine were taken at the department of radio diagnosis, Kasturba medical college hospital, Attavar, Mangalore by the same technician for all the subjects who was blinded from the study.

Independent observer

Subjects were given a detailed description about the procedure and written consent was obtained for participation in the study. Subjects were assessed in the order of presentation to the department. All subjects were examined in the same time of the day (10 am to 12 pm) to minimize the effect of circadian variation on the findings of spinal examination [17]. Subjects were included after the screening examination (given in the appendix- II).

Technique of application of central PA pressure

Position of Subject

During the procedure, he / she was asked to be as relaxed as possible and was asked to report any pain or discomfort immediately. During testing subject was asked to hold the breath at the end of normal expiration during each trial and was allowed to breathe between trials (since tidal breathing changes the PA stiffness) 9. Subjects were asked to turn the face to other side to that of examiner (to avoid bias in application of the grades relative to the facial expression).

The subjects were positioned prone with arms by the sides, pillow under the subject's shin to maintain the knees in slight flexion [3]. All the subjects were assessed on the same plinth (since difference in plinth padding changes the PA stiffness) [9] in the same position described (to avoid changes in lumbar PA stiffness with change of positions [10] and to avoid the sagittal plane rotation of pelvis [10] which might alter the PA stiffness).

Surface Marking

Level of L5 was traced from inter-space between L4 and L5 from the highest point of iliac crest and was marked with a marker. Level of L1 was traced from lower end of 12th ribs corresponding to L2 and was marked with a marker.

Technique

The therapist stands by the side of the plinth in walk stance position. The arms were aligned parallel to each other and straight such that both the thumbs are extended and opposing on each other's dorsum and vertically aligned to the spinous process of lumbar vertebra. The PA pressure was applied from the shoulders and upper trunk. The direction of application of the pressure was vertical, to both the

levels for all three grades for all the subjects (since lumbar PA stiffness changes with the change in direction of the applied force) [10]. The tester assessed the amount of inter-segmental mobility and the resistance [3] (see figure).

Fig. 1: showing the technique of application of Central Postero Anterior (PA) Pressure on the lumbar spine

Then the joint play is graded according to the scale as follows:

Grade 0: Ankylosed, Rigid (similar to applying pressure on wood- no movement possible)

Grade 1: Considerable Hypomobility (minimal movement possible with applying greater pressure, may accompany with pain- pressure on thick rubber ball)

Grade 2: Mild Hypomobility (movement is possible with resistance starting at the beginning of range or staying throughout the range- pressure on thin rubber ball)

Grade 3: Normal Mobility (movement is possible with resistance felt at the end of range, with an elastic rebound or dense oily feel- pressure on soft rubber)

Grade 4: Mild Hypermobility (movement is possible with absence of resistance at end of range or resistance is felt later in the range than normal- pressure on oil inside a balloon)

Grade 5: Considerable Hypermobility (increased movement range possible without any resistance, may accompany with spasm- pressure on water inside a balloon)

Grade 6: Unstable (movement detected even without application of pressure, a visible or palpable step sign may be noted, thus contra indicating therapist from applying any pressure-pressure on air inside a balloon)

The scale was found to have acceptable intra and inter tester reliability in manual assessment of subjects with non specific low back pain. Three trials of assessment were done at each level and the mode was taken as the grade of joint play at that particular spinal level.

Functional Radiography

The functional radiographs were taken and each of the film- flexion view and extension view are assessed by tester IV separately.

Flexion Radiograph

The radiograph is traced on to a transparency for the margins of the vertebral body. Then the postero-superior (PS) and postero-inferior (PI) points of the vertebral body are marked. Similarly the antero-superior (AS) and antero-inferior (AI) points are marked. This marking is done for all the vertebral bodies of lumbar vertebrae and the sacrum.

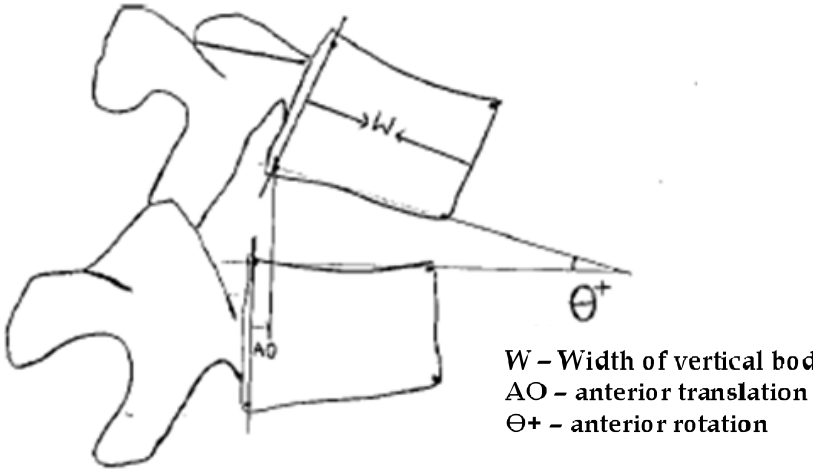
For Measuring Anterior Translation

Join PS and PI of the lower vertebra. Draw a line from PI of the upper vertebra parallel to the earlier line. The perpendicular distance between the two lines drawn will measure the anterior translation of the upper vertebra over the lower one during flexion.

For Measuring Anterior Rotation

Join PI and AI of the upper vertebra. Join PS and AS of the lower vertebra. Project these two lines to form the angle of anterior rotation of the upper vertebra on the lower one during flexion.

Fig. 2: Technique of measurement of anterior translation and positive / anterior rotation on lateral view of the lumbar spine in flexion.



Extension Radiograph

The radiograph is traced on to a transparency for the margins of the vertebral body. Then the postero-superior (PS) and postero-inferior (PI) points of the vertebral body are marked. Similarly the antero-superior (AS) and antero-inferior (AI) points are marked. This marking is done for all the vertebral bodies of lumbar vertebrae and the sacrum.

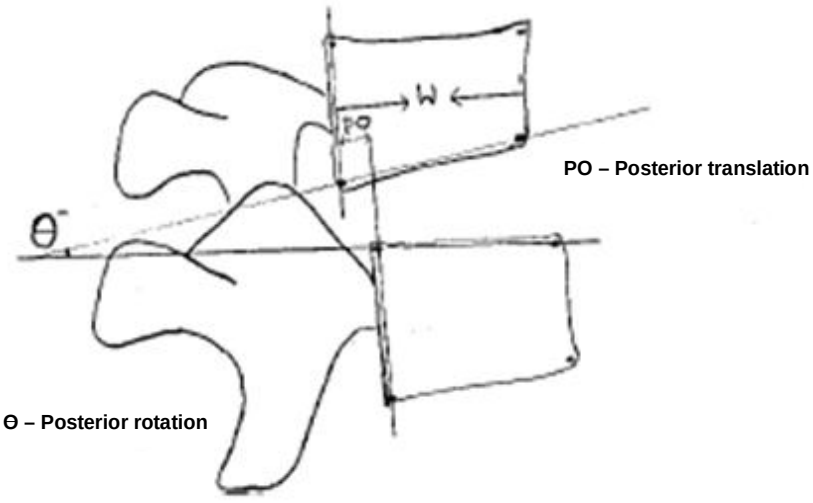
For Measuring Posterior Translation

Join PS and PI of the lower vertebra. Draw a line from PI of the upper vertebra parallel to the earlier line. The perpendicular distance between the two lines drawn will measure the posterior translation of the upper vertebra over the lower one during extension.

For Measuring Posterior Rotation

Join PI and AI of the upper vertebra. Join PS and AS of the lower vertebra. Project these two lines to form the angle of posterior rotation of the upper vertebra on the lower one during extension.

Fig. 3: Technique of measurement of posterior translation and negative / posterior rotation on lateral view of the lumbar spine in extension.



Data Analysis

The grades of joint play obtained in manual examination of lumbar spine using central postero anterior pressure was compared with interpretation of lumbar inter-segmental mobility from functional radiography of lumbar spine using Karl Pearson Correlation Co efficient (KPCC). Confidence interval was kept at 95%. The analysis was done using SPSS 12.0.1 for windows.

Results

Key

JPGS- joint play grading scale

AT- anterior translation

AR- anterior rotation

PT- posterior translation

PR- posterior rotation

From the tables, it is evident that there was a comparable change in the segmental mobility measured using manual and radiological examination in all the five subjects studied. This finding is specifically noted between the JPGS with posterior rotation and anterior translation. E.g., a normal mobility on JPGS at L1 was seen with normal anterior translation and posterior rotation values from X-ray but not in posterior translation and anterior rotation. Following table showing Karl Pearson's Correlation Coefficient values for the variables measured.

Spinal levels	JPGS & AT	JPGS & AR	JPGS & PT	JPGS & PR
L1	.919 *	.745	.167	.913 *
L2	.913 *	-.327	-.200	.913 *
L3	.953 *	.620	.423	.930 *
L4	.919 *	-.134	.408	.919 *
L5	.913 *	-.645	-.408	.913 *

* - indicate level of significance p < .05

Table 1: Grades of joint play (as put forth by Stanley v Paris)

Grades of Joint Mobility	
Grade 0	Ankylosed
Grade 1	Considerable Hypomobility
Grade 2	Mild Hypomobility
Grade 3	Normal mobility
Grade 4	Mild hypermobility
Grade 5	Considerable hypermobility
Grade 6	Unstable

Discussion

The current study showed that manual examination findings of intervertebral mobility correlated with the radiological findings in all the five asymptomatic subjects studied. This study has following implications:

- Manual examination of intervertebral mobility using the central postero anterior pressure is equivalent to radiological examination.
- The joint play grading scale could further be evaluated for its reliability and validity so that it could be easily applied to all subjects and it would be a useful clinical tool in assessment of PAIVMs.
- The comparable nature of anterior translation and posterior rotation measured radiologically to manually could be because of the mechanics of the central postero anterior pressure that it produces anterior translation and posterior rotation of the tested vertebral segment.
- Further studies could be performed on a larger sample size and comparison with mechanical low back pain subjects.

Conclusion

The study showed that manual examination of intervertebral mobility using central postero anterior pressure was comparable to the radiological assessment of intersegmental mobility of the spine in the forty eight asymptomatic participants studied.

This significant correlation was noted especially for the anterior translation and posterior rotation radiological measurements with the manual assessment using the central postero anterior pressure.

The joint play grading scale was a useful clinical tool to measure and record intervertebral mobility in the five normal subjects studied.

Acknowledgments

The author wishes to thank the study participants for their whole-hearted co-operation towards this study.

Other information

The study was previously presented as a platform presentation at 44th annual conference of Indian Association of Physiotherapists (IAP), at Ahmedabad in 2005.

Conflicts of interest

None identified and / or declared.

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Original Article

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Physiotherapy Students' Perception on Learning through Smartphone: A Pilot Study

Thirumalaya Balaraman

Abstract

Objectives: Smartphone technology has transformed our lives in many ways and it is also reflected in learning. The objective of this pilot study was to find out the physiotherapy students' perception on the use of smart phone and medical related applications (apps) as a learning tool in a private university in Malaysia. *Methods:* The method used in this study was an online survey. The link for the online survey form was posted on the Facebook page of the university Physio-Club and the participation in the survey was voluntary. The students have to answer close ended questions related to the ownership of the smart phone; frequency, duration and purpose of smart phone and medical related apps use for their learning, in university and clinical environment. Open ended questions were also used to explore the students' perception about the usefulness of the applications, and their recommendations. *Results:* 68 students responded to the questionnaire of which 69.1% and 30.9% were female and male students respectively. Google Android was the most popular among the students (61.8%) followed by iPhone (25%). The majority (63.2%) of the students possessed 1to5medical related apps in their Smartphone. Their preferred use was, for educational learning (79.4%) and revising (74.6%), with less usage in clinical ward (30.2%) and clinic (20.6%) environment. Their usage frequency was once or twice a day with duration lasting between1and10minutes, in university as well as in a clinical environment. They often used the smart phone and applications to find out the disease diagnosis / management and they found it most useful due to easy accessibility of information. *Conclusion:* This pilot study showed that most of the physiotherapy students use medical related apps in their Smartphone for learning activity, and they mostly recommended dictionary and physiotherapy apps.

Keywords: Physiotherapy Students; Smart Phones; Medical App; Survey.

Introduction

A mobile device which has advanced capabilities beyond ordinary mobile phone is called a smart phone. Smartphone technology has transformed our lives in many ways and its influence can be seen in various fields like medicine [1], teaching and learning [2]. Smartphone applications (apps) have changed the way people do their jobs. Since the introduction of medical related applications, smart phone has been used widely in the medical field for assessment [1, 3] and management of patients [1, 4, 5]. It is also used to educate the patients about health related conditions and self-management of chronic diseases [1]. The use of a smart phone for learning is also increasing and various studies explored the use of a smart phone among university students [6-8]. The increasing number of smart phone apps brings the solution for more complex problems in the student's hands and it's no wonder that smart phones is popular among the student community. Its use is also echoed in the medical students' community for learning.

Previous studies explored the usage of smart phone among medical students and their use for learning [9]. Medical students are using smart phone and medical related apps for learning not only in university campus but also in the clinical setting [10]. Likewise, smart phone and medical related apps usage among health science students especially physiotherapy students has to be assessed.

With the use of body measurement Smartphone apps students can measure the patient joint angles accurately without any sophisticated equipment [3]. Recent research has proved that posture and gait assessment can also be done with a Smartphone app [11, 12]. Smartphone apps can also be used for fall

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prevention [13], activity monitoring [14], and providing treatment like balance training [15]. As rehabilitation related apps are increasing we presume that physiotherapy students also using Smartphone for their learning in academic as well as in a clinical setting. Even though previous studies analyzed the use of Smartphone among medical students, the physiotherapy students' perspective was not analyzed specifically, especially in Malaysia. Hence, this pilot study is planned to find out the use of Smartphone and medical related apps among physiotherapy students which will help us to transform our course delivery in teaching. So the main objective of this pilot study is to find out the physiotherapy students' perception on use of smartphone and medical related apps for learning in a private university in Malaysia.

Methods

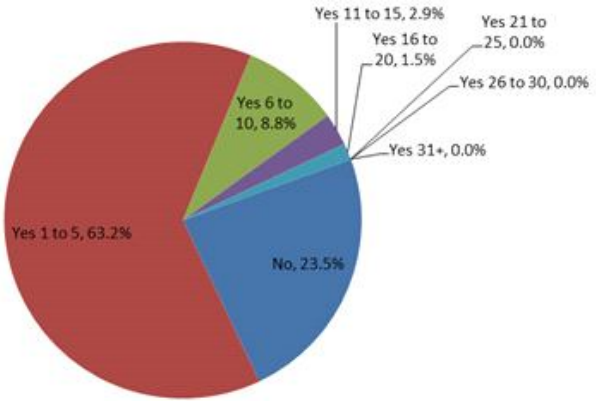
The method used in this study was a descriptive online survey. The questionnaire used in this study was adopted and modified from the questionnaire used by Payne et al [10], with permission. The original questionnaire was tested with 20 physiotherapy students and modified accordingly. Then the 12 item questionnaire was created in the Google docs (www.*docs.google.com)* and the link for the online survey form was posted on the Facebook page of the INTI International University Physio-Club for 3 weeks. The participation in this survey was voluntary. All the physiotherapy students of INTI International University are the members of the INTI Physio-club page on Facebook. Hence, anyone from year 1 to year 4 can access and answer the questionnaire. When they click the online survey form link on Facebook, a separate page in Google docs will open with informed consent and the questionnaire. After reading the informed consent if the student wishes to continue, then they have to answer close ended questions related to their gender, current year of study, ownership of the Smartphone and medical related applications, frequency, duration and purpose of smartphone and medical related apps use for their learning, in university and clinical environment. The usage of university linked application among students' is also explored with a closed ended question. Open ended questions were also used to discover the students' perception about the usefullness of the applications, and their recommendations. Please find the questionnaire in the appendix.

After 3 weeks the link was closed and the numerical data were analyzed using Microsoft Excel (MS office 2010), Statistical Package for Social Sciences (SPSS version 13) and online tool Simple Interactive Statistical analysis (SISA). The descriptive statistics were analyzed for frequency and percentage by entering data from Google docs into Microsoft excel. The inferential statistics for non- parametric Fisher's Exact Test was run using SPSS and SISA as appropriate. The response to the open ended questions were organized into key themes and discussed in the results.

Results

Of the undergraduate physiotherapy students surveyed 68 students responded, out of 156 registered physiotherapy students; with a response rate of 43.6%. Out of 68 responses 69.1% (n=47/68) of the students were females and remaining 30.9% (n=21/68) were males. The recorded responses were from 4th year (33.8%), 3rd year (44.1%), 2nd year (22.1%) and no first year student answered the questionnaire. Google Android (61.8%, n=42/68) was the most popular smartphone followed by iPhone (25%, n=17/68) and other smartphone (13.2%, n=9/68) among physiotherapy students.

Fig. 1: Percentage of physiotherapy students owning medical related smartphone apps (n=68)



The majority of the students (63.2%, n=43/68) owned 1 to 5 medical related apps in their smartphone. Whereas 23.5% (n=16/68) students did not own any medical related apps in their smartphone. There was no association between gender and ownership of medical related apps (Fisher's Exact Test, P=1.000). Similarly no association was found between the type of phone and ownership of medical related apps (Fisher's Exact Test, P=0.17688).The students used mostly smartphone for educational learning (79.4%, n=50/68) and educational revision (74.6%, n=47/68), and their usage in the clinical area was limited representing 30.2% (n=19/68) in a ward environment and 20.6% (n=13/68) in a clinic environment. The figure 2a and 2b shows the frequency of usage of smartphone and medical related apps in university education and clinical education.

Fig. 2 a: University education

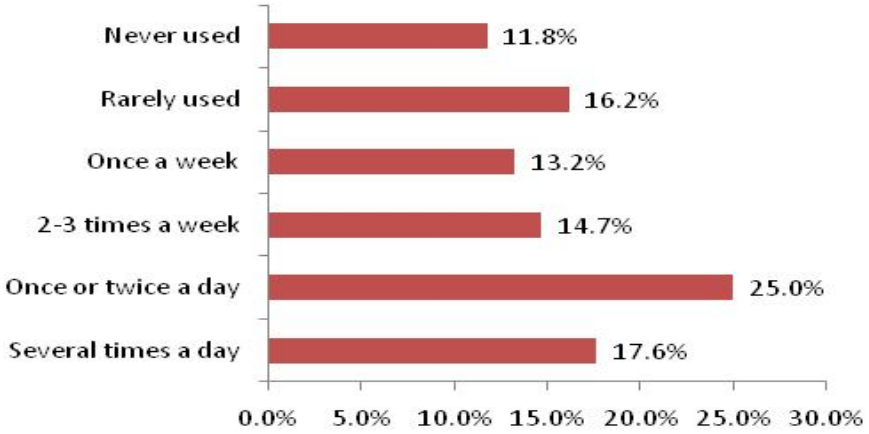
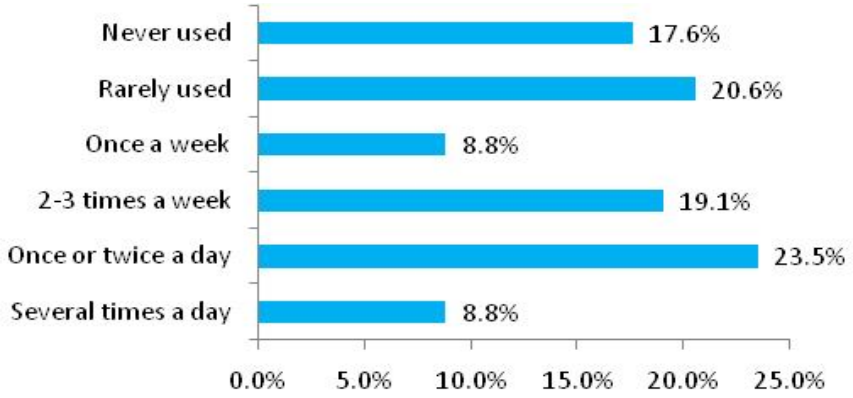


Fig. 2 b: Clinical education



The purpose and frequency of smartphone and medical related apps usage as reported by the students is given in the figure 3. The students stated other uses such as notes, presentation slides, photo, BMI calculator, stopwatch, games and social media (Facebook, Twitter, YouTube, WhatsApp). Daily use (in minutes) of smartphone and medical related apps among physiotherapy students is reported in the figure 4a and 4b. Out of 68 responses 61.8% (n=42/68) of students like to use smartphone apps specific to their university and 38.2% (n=26/68) did not like to use it.

Daily use (in minutes) of smartphone and medical related apps among physiotherapy students is reported below in figure 4a and 4b. (n=68).

More than one third of the students' (n=28/68) responded to the open ended questions about their comments on the use of smartphone and medical related application in university/clinical environment. 9 participants stated that apps are easily accessible and convenient to use. The students also stated that it is helping to get further information on the lecture, assisting to learn technology with education and helping to revise the topic. Four students were not sure about their answer to this question.

Fig. 3: The purpose and frequency of smartphone and medical related apps use among physiotherapy students (n=68)

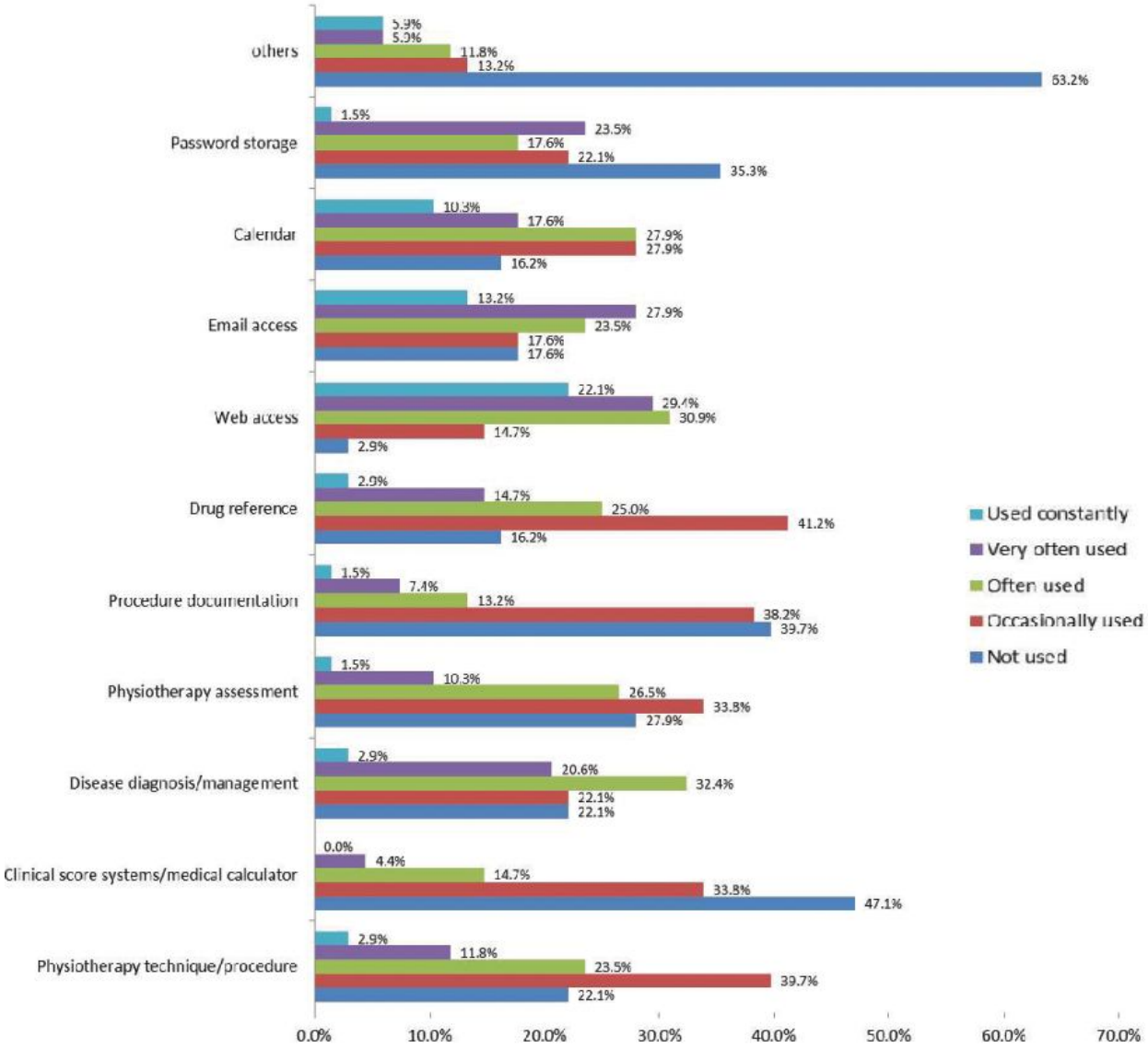


Fig. 4a: Daily use in university setting

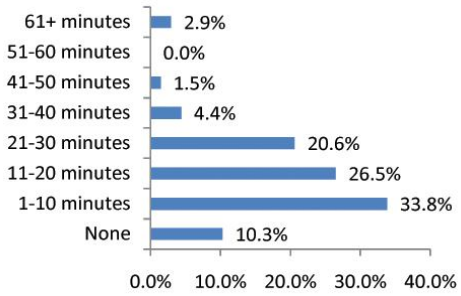
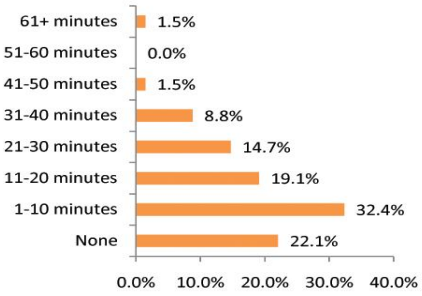


Fig. 4b: Daily use in clinical setting



The physiotherapy students recommended following apps: human anatomy atlas, time tabling, Medscape, PubMed, BMI calculator, disease dictionary, physiotherapy exercises, goniometer, medical diagnosis, medical dictionary, anatomy dissection, webmd, Google and more physiotherapy related apps.

The most useful features of smartphone and medical related apps described by physiotherapy students was drug information and disease diagnosis, medical dictionary with diagram or picture, precise diagrams and explanations, convenient and quick access, summarized information, quick reference, easy to use, and reliable source of information.

Discussion

This pilot study discovers the smartphone and medical related apps usage among physiotherapy students for the first time in Malaysia. Understanding the perception of students about smartphone in learning will help academicians to modify their teaching and course delivery in an exclusive way. It will also help smartphone companies and apps developers to design and modify their software according to consumer preferences.

Even though only one third of the students responded to the questionnaire, all of them owned a smartphone. So the smartphone usage is high among physiotherapy students. This trend is supported by Sedek et al [16] in their study, which reported high amount of the smartphone, tablet and laptop ownership among undergraduate students from Malaysian Technical Universities. Similarly research studies by Kim et al [8] from Korea and Alfawareh HM, Jusoh S [6] from Saudi Arabia stated the peak use of a smartphone among university students.

Google Android phone (61.8%) was popular among physiotherapy students in Malaysia. On the contrary Apple iPhone was the most popular smartphone among Canadian medical students and residents [9], and United Kingdom medical students [10]. The slightly cheaper price of android phone when compared to the iPhone may be influencing consumers to buy android phones in a developing country like Malaysia.

63.2% of the Malaysian students owned 1 to 5 medical related apps in their smartphone which is higher when compared to United Kingdom medical students and junior doctors as reported by Payne et al [10]. However ownership of more than 5 medical related apps is less among Malaysian physiotherapy students when compared to UK medical students. This study does not show any significant association between types of smartphone and ownership of medical related apps which is contrary to the UK study. As medical related apps on Apple App store and Google Play store are numerous with identical functionality, the apps use by both types of smartphone (iPhone and Android) users is almost similar. Only 25% of Malaysian physiotherapy students used smartphone and medical apps, once or twice a day for their university education, which is less than Canadian medical student use(9). As the physiotherapy students in the pre-clinical years (second year) had limited clinical posting, the overall use in clinical education for once or twice a day was slightly lower than university education use.

The percentage of Malaysian students using smartphone several times a day for medical purpose is less; 11.8% and 17.6% of students never used in their university education and clinical education respectively. This displays that physiotherapy students are using their smartphone for medical related educational purpose, but not very frequently.

A review by Ozdalga et al [1] stated many uses of smartphone in medicine. In that he reported the use of a smartphone for patient care and monitoring in various fields like neurology and rehabilitation. The results from this current pilot study reveal that physiotherapy students are often used smartphone for disease diagnosis / management, but they used occasionally for physiotherapy assessment and procedures. But they used very often for web access and email access. Regarding the duration of use, 1-10 minutes per day was reported by most of the Malaysian students. Although this duration is less, it is understandable that the current generation of students wants to enjoy their time by using social media and email which can be seen through peak usage of smartphone for web access and email access in this study. Hence; the duration they use their smartphone for medical related apps is limited.

For open ended questions, most physiotherapy students reported that smartphone is very convenient to use and easy to access and they preferred dictionary and physiotherapy related apps. More than half of the Malaysian students (61.8%) are using university linked apps in their smartphone. So the university has to consider this and make the app more attractive and useful for the students.

No first year students answered the questionnaire. It may be due to lack of awareness of medical related apps use as they just entered the course. Because of this we do not know the first year physiotherapy students' perception about using smartphone for learning.

Limitations

This pilot study was conducted in small groups of students in one university, which may not reflect the larger physiotherapy student population in Malaysia. So studies with larger samples and in different locations have to be conducted in order to confirm the results reported in this study.

These study samples are younger generation students who are tech savvy. So the usage by students does not reflect the usage in the physiotherapist community. Hence practicing physiotherapist also has to be included in future studies.

No first year students answered the questionnaire. Hence the result may not reflect the complete picture because first year students do not have clinical posting

which may affect the result of clinical setting usage.

Conclusion

From this study it is clear that physiotherapy students are using smartphone for their learning in university education as well as in a clinical setting. But their preference concerning the type of smartphone varies from western country students. Physiotherapy students prefer to use medical related apps in their university education for learning, but their usage in clinical setting is less. The increasing trend of smartphone and medical related apps use among students urges physiotherapy academicians to incorporate smartphone technology in their teaching. As physiotherapy students desiring more physiotherapy related apps, the app developers including university have to consider the students' opinion for their future business and development.

Appendix

* Required

1. Please state your gender: *
   Mark only one oval.
   - ◯ Male
   - ◯ Female

2. Please state your current year of study: *
   Mark only one oval.
   - ◯ 1st year
   - ◯ 2nd year
   - ◯ 3rd year
   - ◯ 4th year

3. Do you own an application smartphone? *
   Mark only one oval.
   - ◯ No
   - ◯ Yes-iPhone Yes-Google Android Yes-
   - ◯ Other smartphone

4. Concerning your smartphone, do you own medical related applications? *
   Mark only one oval.
   - ◯ No
   - ◯ Yes 1 to 5
   - ◯ Yes 6 to 10
   - ◯ Yes 11 to 15
   - ◯ Yes 16 to 20
   - ◯ Yes 21 to 25
   - ◯ Yes 26 to 30
   - ◯ Yes 31+

5. Please indicate how you use smartphone and medical related app:
(You may choose more than one answer)
Check all that apply.

- [ ] Education-revising
- [ ] Education-learning
- [ ] Clinical-ward environment
- [ ] Clinical-clinic environment

6. Please estimate the frequency you utilize your smartphone and medical applications during clinical attachment compared to university educational time. *
(One of the below options chosen for the categories: 'university education' and 'clinical attachment')
Mark only one oval per row.

	Several times a day	Once or twice a day	2-3 times a week	Once a week	Rarely used	Never used
University education						
Clinical education						

7. In relation to the following types of applications, please indicate how often you use them during educational and/or clinical hours: *
(choice of 'not used', 'Occasionally used', 'often used', 'very often used' and 'used constantly' for each of below. Please select your choice.)
Mark only one oval per row.

	Not used	Occasionally used	Often used	Very often used	Used constantly
Physiotherapy technique/Procedure					
Clinical score systems/medical calculator					
Disease diagnosis/management					
Physiotherapy assessment					
Procedure documentation					
Drug reference					
Web access					
Email access					
Calendar					
Password storage					
Other (please detail in comment box)					

Please detail in comment box if you have selected Other

8. Please estimate the time you spend per day (in minutes) using smartphone and medical related applications related to clinical and educational activities *
(One of the below options chosen for the categories 'education' and 'clinical', please circle your option)

Mark only one oval per row.

	None	1-10 minutes	11-20 minutes	21-30 minutes	31-40 minutes	41-50 minutes	51-60 minutes	61+ minutes
Education	◯	◯	◯	◯	◯	◯	◯	◯
Clinical	◯	◯	◯	◯	◯	◯	◯	◯

9. Would you utilize a smartphone app specific to your university? *

Mark only one oval.

Yes ◯

No ◯

10. Please detail any further comments you have regarding your use of medical related smartphone application in the university and/or clinical environment:

11. Which specific apps would you recommend?

12. What features do you find most useful in a medical related app?

If you would like a summary of my findings, please fill in your name and email address on this form and I will be happy to forward my findings to you when the study is completed.

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Original Article

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A Study to Evaluate the Prevalence of Anxiety and Depression in Cardiopulmonary Patients

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Abstract

Background and purpose: Earlier the recognition of psychological states like anxiety and depression had shown the poor prognosis and non-adherence to the interventions given in chronic illness. There are few studies in India evaluating the association between the psychological impairments with cardiac and chronic pulmonary diseases. Future studies with larger sample and longer periods of follow up are needed to validate the findings and to assess the long term burden of psychological issues following the chronic disorders. The aim of this study is to evaluate the prevalence of anxiety and depression in cardiopulmonary patients. *Methods:* A survey of a sample size of 300 had done among cardiac and pulmonary disease patients. Participants completed a questionnaire along with the demographic information about them; designed to determine symptoms of anxiety and depression. Responses are summarized for each item and the data was analyzed to examine the relationship between the diseases and the psychological impairments like anxiety and depression. *Results:* The study investigated the prevalence of undiagnosed anxiety and depression in cardiac and pulmonary patients. This study illustrates the prevalence of cardiac and pulmonary patients that 36% of patients suffered from anxiety and 62.67% had depression in cardiac illness; and in pulmonary patients 38.67% suffered from anxiety and 72% had depression. The study revealed positive outcomes that anxiety and depression symptoms are present in cardiac and pulmonary patients based on HADS score. *Discussion and conclusion*: The prevalence of anxiety and depression in Indian patients following the cardiac and pulmonary disorders are high. This study proves an association between the cardiopulmonary diseases and symptoms of anxiety and depression. It shows that it is important to screen for symptoms of anxiety and depression in cardiac and pulmonary patients for possibility of depression and anxiety treatment. Detection and management of these mental disorders may ameliorate prognosis of the cardiac and pulmonary diseases and improve the adaptation and quality of life of these patients.

Keywords: Anxiety; Depression; Cardiac Diseases; Pulmonary Diseases; HADS.

Introduction

Cardiopulmonary diseases are the disorders that affect the normal functioning of the heart and lungs which will lead to the worsening of physical, mental and social well-being of an individual. Common cardiopulmonary diseases comprises of: Cardiovascular diseases includes coronary heart diseases, rheumatic heart diseases, valvular heart diseases; congestive heart failure; diseases of pulmonary circulation. There are several Pulmonary diseases which includes COPD, asthma, chronic restrictive pulmonary diseases, pneumonia, tuberculosis [1]. Cardiovascular Diseases (CVD) is considered as the most dominant chronic disease which is spreading globally in different parts of the developing world [2]. It is predicted that by 2020, CVD will be act as a leading cause of death and disability in the developing nations [3]. Globally, in United States over 6,00,000 people die because of CVD. Worldwide over 80% of the deaths are due to the CVD which is most commonly occur in lower and middle income countries. India is a developing country, in 2006 it was predicted that it accounts for 40-60% of CVD cases and the incidence is continuously increasing from 2% to 6% in rural region while 4% to 12% in urban region [3,6]. Epidemiological studies reveals that in India 32

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million people are suffering from CHD and among those 30% are below 40 years of age [7] and by 2015 it will become the most leading cause of mortality in India [8] . As India is a developing country for the youth, the age group of >60 years in which majority of the population are poor includes 5% of the total population suffering from CVD and the level may increase by 2016 [2]. Chronic Respiratory Diseases is another most common disease now-a-days. The most common among them are COPD and asthma. The COPD is expected to be the third leading cause of death in 2020 globally [9]. In the context of WHO, worldwide approximately 3 million people die because of COPD [10]. It has been estimated that Asthma would have affected approx. 300 million people around the world [11]. In the Indian context, several studies had done based on the prevalence of asthma and COPD. At the state level, the prevalence of asthma in Chandigarh, Delhi, Bangalore, and Kanpur has been estimated to be 2.38% in individuals of over 15 years of age. Respiratory symptoms are present in 4.3-10.5% of individuals [12].

Comorbid psychological impairments like anxiety and depression acts as a risk factor for increased disease severity [13]. Depression and anxiety occur at higher rates among patients suffering from CVD [14] and pulmonary disorders [15]. Patients with several chronic physical illnesses including heart disease and chronic respiratory diseases are suffering from anxiety [16]. Both short term and long term recoveries are affected by Anxiety [17] as it can lead to interfere with taking medications, taking proper diet, getting a quality sleep, connecting with family members and friends and again go back to their jobs [18]; while long term depression can lead to poor adherence and reduces the chances of quitting smoking, taking medications, exercising, and attending cardiac rehabilitation [19]. The depressive and anxiety symptoms can lead to a significant impact on the patients quality of life and lead to poor prognosis of the disease [20]. Researchers suggest that depression and anxiety remain unrecognized in patients with coronary heart disease and chronic lung diseases. Depression is highly prevalent and under-recognized and among 31-45% of patients with CVD suffer from depressive symptoms and symptoms of anxiety are also seen in patients with acute cardiac conditions and in patients with stable CAD and in patients with pre and post CABG [24].

As anxiety and depression remains unrecognized, thus screening of these symptoms are extremely important [26]. Anxiety and depression were assessed by using Hospital Anxiety and Depression Scale (HADS) [16,27]. The HADS has the advantage of screening out both the depression (HADS-D) and anxiety (HADS-A) in a single scale [29]. HADS is a widely used instrument for assessing anxiety and depression symptoms. HADS was developed by Zigmond and Snaith in 1983 [30]. The scale has been widely used in more than 25 countries and translated in many languages. It consists of 14 questions which comprising 7 for anxiety and 7 for depression [29,32]. HADS is a reliable and valid instrument for assessing anxiety and depression in chronic illnesses. The scores can be taken from the range of 0-21 for each anxiety and depression. A score of 0-7 is considered as Normal, 8-10 is Mild, 11-14 is moderate and 15-21 is severe [31]. Recent research has highlighted that increased levels of anxiety and depression has to be identified so that psychological intervention should be given on time [32]. The pulmonary/cardiac rehabilitation and psychotherapy play a significant role in lowering these symptoms [33]. It was shown that exercise can reduce the symptoms of depression and anxiety in Coronary Heart Diseases(CHD) and Chronic Lung Diseases(CLD) like asthma, COPD [35,36]. However to prevent poor prognosis of the disease the rehabilitation program includes exercise, strength training, relaxation, counselling sand stress management [36,37]. Thus it becomes necessary to identify these symptoms for the early intervention. The main objective of this study is to evaluate the prevalence of anxiety and depression in cardiac patients and in patients suffering from respiratory disorders.

Methodology

Sample Size

300 Patients were included in the study.

Source of subjects

Safdarjung Hospital, New Delhi

Sample Method

Convenient Sampling

Method of selection

Inclusion Criteria

1. Age group between 20-70 years,
2. Both the genders males and females,

3. Able to understand and follow commands appropriately,
4. Haemodynamically stable patients,
5. Including patients of both cardiac and pulmonary patients.

Exclusion Criteria

1. Subjects who are not able to answer,
2. Subjects who had unstable chronic problems,
3. Any other neurological or musculoskeletol problems affecting the present illness,
4. Any diagnosed psychological disorders,
5. Subjects having language barriers.

Methods of assigning subjects

The subjects were non-randomly selected. 300 subjects were taken from which 150 subjects were suffering from cardiac illness and 150 subjects were suffering from pulmonary disorders.

Study design

It is a Non-experimental cross-sectional survey study.

Instrumentation

Hospital Anxiety and Depression Scale (HADS)

Protocol

A sample size of 300 patients both male and female participated in the study. Among 300 Patients, 150 were cardiac patients and 150 were pulmonary patients; and they were provided with a Hospital Anxiety and Depression Scale (HADS) questionnaire.

Procedure

The study is observational in nature and is a survey based study so as to accommodate patients of both genders. The subjects were selected from the general community setting and all had an illness history of at least 5 years. Subjects were taken from the Department of Cardiothoracic and Vascular Surgery (CTVS) for cardiac disease and for the pulmonary disease subjects were taken from the OPD of the Respiratory Department of the Safdarjung Hospital. The study included a set of questionnaire known as Hospital Anxiety and Depression Scale (HADS). Subjects were included based on the inclusion and exclusion criteria. The subjects were made to sit relaxed so as to prevent their distraction from the outside environment. The attendants were made to sit outside in order to avoid any disturbance while answering the questionnaire. Once the subject becomes relaxed and comfortable with the environment, history regarding the disease and the demographic details of the subject were taken. Once all the details were taken. Subjects were explained regarding the significance of the questionnaire that how the information would be useful in improving their social and emotional wellbeing and helps in preventing the worsening of the symptoms and prognosis of the existing illness. The subjects were asked to complete a questionnaire composed of statements relevant to their generalized anxiety and depression. The subjects were asked to read out aloud one or other phrases of the questionnaire. This also provides opportunity to provide assurance that, as with all clinical information, it is a confidential document which will aid their doctor to help. Major emphasis was given on confidentiality of the data collected from the subjects participated and the interview was only conducted after the consent taken from the subjects.

Data Analysis

The data was analyzed using statistical software namely SPSS 18.0 and Microsoft word and excel has been used to generate graphs, tables, etc. The independent t-test and Mann-Whitney test was applied for the comparison of HADS-A and HADS-D score, including parameters like age and gender within the group. The independent t-test was applied for the comparison between the gender and age of the group. The test was applied at 95% confidence interval and p value set at 0.05. The results were taken to be significant if $p<0.05$.

Results

The demographic data was analyzed by comparing means of descriptive. The mean of age (minimum 20 years and maximum 70 years) is 43.06. Between the group analysis indicate that the difference in the distribution of demographic data (age) between cardiac and pulmonary patients was not statistically significant 'p' value 0.877. A total of 152 males and 148 females are participated in the

study in which cardiac patients included 62 males and 88 females, pulmonary patients included 90 males and 60 females. The prevalence of anxiety score in cardiac patients was 36% and depression score was 62.67%. The prevalence of anxiety score in pulmonary patients was 38.67% and depression score was 72%.

Table 1: Percentage of prevalence of Anxiety score between cardiac and pulmonary patient

Anxiety score	Total no of patients	Anxiety	Percentage
Cardiac	150	54	36%
Pulmonary	150	58	38.67%

Fig. 1 : Percentage of prevalence of Anxiety score between cardiac and pulmonary patient

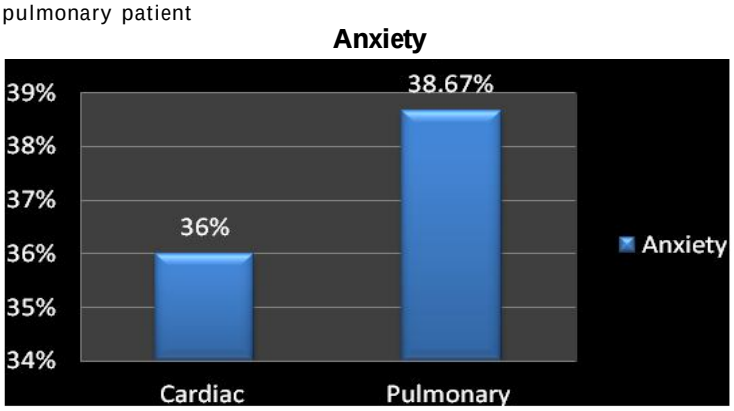
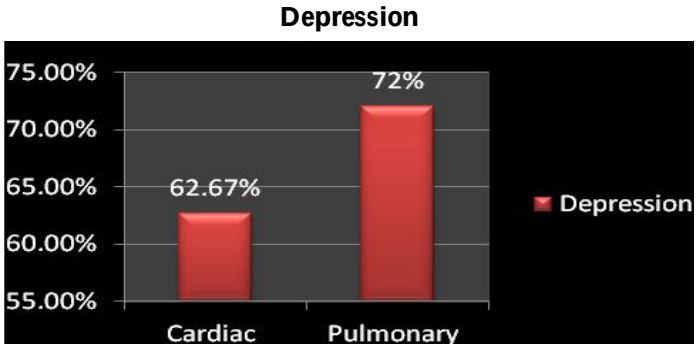


Table 2: Percentage of prevalence of Depression score between cardiac and pulmonary patient

Depression score	Total no of patients	Depression	Percentage
Cardiac	150	94	62.67%
Pulmonary	150	108	72%

Fig. 2: Percentage of prevalence of Depression score between cardiac and pulmonary patient



Multiple Comparisons between Cardiac and Pulmonary patients based on scoring of HADS:

Anxiety scoring: The total number of patients under Normal scoring is 188 (Cardiac n=96, Pulmonary n=91), under mild scoring 85 (Cardiac n= 47 , Pulmonary n=38) , under moderate scoring 25 (Cardiac n=7, Pulmonary n= 18), under severe scoring 2 (Cardiac n=0, Pulmonary n=2).

Depression Scoring: The total number of patients under Normal scoring 98 (Cardiac n=56, Pulmonary n=42), under Mild scoring 117 (Cardiac n=59, Pulmonary n=58), under Moderate scoring 82 (Cardiac n=34, Pulmonary n=48), under severe scoring 3 (Cardiac n=1, Pulmonary n=2).

Comparison according to Gender within the groups:

Within cardiac patients analysis showed that there is a significant difference in the score values HADS-D (Male 7.35 ±2.60, Female 8.78 ±2.71) of depression('p' value 0.002) and HADS-A (Male

5.77±2.25, Female 7.30 ±2.33) of anxiety ('p' value 0.000) between gender. Within pulmonary patients analysis showed that there is no significant difference in the score values HADS-D (Male 8.72 ±2.74, Female 9.35 ±2.82) of depression ('p' value 0.152) and HADS-A (Male 7.01 ±2.77, Female 7.80 ±3.20) of anxiety ('p' value 0.281) between gender.

Discussion

In the present study, we investigated the prevalence of undiagnosed anxiety and depression in cardiac and pulmonary patients. This study illustrates the prevalence of cardiac and pulmonary patients that 36% of patients suffered from anxiety and 62.67% had depression in cardiac illness; and in pulmonary patients 38.67% suffered from anxiety and 72% had depression. The study revealed positive outcomes that anxiety and depression symptoms are present in cardiac and pulmonary patients based on HADS score. The raised mean difference of anxiety score (Cardiac 6.67 ±2.41, Pulmonary 7.32 ±2.97) and depression score (Cardiac 8.19 ±2.75, Pulmonary 8.97 ±2.78) in all cardiac and pulmonary conditions indicate that most of the subjects are suffering from subclinical anxiety and depression irrespective of the disease severity.

Cardiovascular disease (CVD) is considered as the leading cause of deaths in globally as well as in middle and low income countries like India. Some previous studies had stated that there was a range of anxiety (5%-10%) and depressive (15-20%) symptoms in cardiac outpatient wards. Acute psychological stressors and personality characters proved to act as risk factors for cardiovascular diseases, and the recent study concluded that anxiety and depressiom are the independent risk factors that affects that affects the mortality and morbidity of the patients with cardiac disease. Respiratory diseases are the leading cause of morbidity and the prevalence of diseases asthma, COPD are high. Female sex, advancing age, lower socio-economic status were associated with significantly higher odds in having asthma [33]. The prevalence of depression COPD in general population of India varies from 21% to 83% and a large study from the urban areas of the south India reported the prevalence of depression were 25.7% among population of more than 6o years of age [44].

Studies had concluded that rate of anxiety symptoms in COPD are higher, ranging from 13% to 51%, and are higher in patients with heart failure, cancer and other medical conditions [36]. In the present study it was found that the rate of anxiety symptoms are approximately same in patients with cardiac and pulmonary diseases. Studies had found that the prevalence of depression in COPD patients with severe airway obstruction (FEV_1<50%) was 25% and that they had a 2.5 times greater risk of depression that controls who were comparable for demographic variables. It was found that living alone, reversibility in FEV_1% predicted, respiratory symptoms, and physical impairments were related to depression in patients with COPD. In recent study it was found that there is an association between the chronic pain and depression. Chronic respiratory diseases are associated with chronic psychogenic and somatic pain, frequent hospital admissions, dependency on hospital and oxygen. This metaphorically suffocating disease may increases the percentage of depression in patients with pulmonary disease [15]. Several studies had reported that so many factors are responsible for a higher rate of depressive symptoms in pulmonary patients as they are having longer periods of suffering, hospitalizations, sense of hopeless and social cutoff [33]. Depression in patients with chronic pulmonary diseases are also having anxiety and it increases with an increase in the chronicity of the disease. Patients with pulmonary disease cannot able to cope with their daily needs adequately, thus this will lead to increase in anxiety and depression in patients and will be responsible for the worsening of the condition [15]. The findings of the current study revealed that pulmonary patients had higher depressive symptoms than cardiac patients.

Women are more sensitive to psychological trauma; cardio-vascular events can result in vulnerability to trauma or deterioration of the previous psychological trauma or anxiety symptoms. The results of our study, supported by the previous study, indicated that the prevelance of depression is relatively high in womens with cardiac disease as that of male. The changes in the performance of autonomous nervous system and decrease in regulatory of vagus nerve can affect regulation of blood pressure and possibly the escalation of blood pressure. Besides, depression through the promotion of unhealthy behaviours like unhealthy diet, lack of exercise and physical activity can result in hypertension. From another point of view, depression can be one of the side effects of anti-hypertension medicine or can independently develop in hypertensive patients. The prevalence of depression is high in patients with CHD and it is having a significant impact on patients quality of life and treatment adherence [8]. Depression and

anxiety in cardiac diseases associated with progression of the illness [5].

This study shows that psychological impairments anxiety and depression are present following cardiac and pulmonary illness. These symptoms were measured by using a scale, Hospital Anxiety and Depression Scale(HADS) [28]. Evidence shows the HADS to be valid and reliable measuring instrument which can analyses a two-factor solution in accordance with HADS subscales for anxiety (HADS-A) and Depression (HADS-D). Anxiety and depression have prognostic importance in patients with stable CAD and respiratory disorders [40]. Thus the patients with elevated symptoms of anxiety and depression seems to be a good strategy for recruitment in clinical trials and preventing the consequences of psychological risks.

Limitations

1. Limitation is the small sample size of the study.
2. The number of patients are taken from the single centre.
3. Another limitation is the language barrier.

Conclusion

Anxiety and Depression symptoms are common in cardiac and pulmonary diseases and the prevalence of anxiety and depression in Indian patients following the cardiac and pulmonary disorders are high. This study proves an association between the cardiopulmonary diseases and symptoms of anxiety and depression. The level of anxiety and depression were compared and it was found that depressive symptoms are present more in pulmonary patients as that of cardiac patients. It also show that women in cardiac illness are more likely to develop depressive symptoms as that of men.

It shows that it is important to screen for symptoms of anxiety and depression in cardiac and pulmonary patients for possibility of depression and anxiety treatment. Detection and management of these mental disorders may ameliorate prognosis of the cardiac and pulmonary diseases and improve the adaptation and quality of life of these patients.

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Review Article

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A Critical Review on the Normal Postural Control

Asir John Samuel*, John Solomon, Divya Mohan*****

Abstract

Postural control evolves from an interaction of the individual with the environment and the task. It emerges from a complex interaction of neural and musculoskeletal system, together referred as the system of postural control. Research into balance and postural control has shifted and broadened over the past few decades. To date, only few reviews were performed with reference to balance. However, with regard to postural control, no such review has been done. Here, we present a critical review on normal postural control. Relevant literature search was performed through the electronic databases of PubMed, Cochrane, CINAHL, Google Scholar, Web of Science, EMBASE, OvidSP and ScienceDirect until December 2010. Literatures available about postural control are limited and about basic its concepts in line with the current knowledge of literature is inconclusive.

Keywords: Balance; Critical Review; Control; Postural Sway; Stability.

Introduction

Postural control involves controlling the body's position in space for dual purposes of stability and orientation. The stability underlying standing quietly (quiet stance) is called static balance. Quiet stance is characterized by small amounts of postural sway. In a perfectly aligned posture, the vertical line of gravity falls in the midline between the mastoid process, a point in front of the shoulder joints, the hip joints, a point in front of the ankle joints [1]. The ideal alignment in stance allows the body to be maintained in equilibrium. Here, the normal postural control is critically reviewed.

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Reflex and postural control

Nashner reported the role of reflexes in controlling posture. He studied on 12 subjects task specific differences of reflex function were investigated by experiments in which the role of stretch reflex to stabilize sway during stance could altered. He reported 5 out of 12 subjects in his study used long-latency (120msec) stretch reflexes to help reduce postural sway. Following an unexpected change in the usefulness of stretch reflexes, the 5 subjects progressively altered reflex again during the succeeding 3-5 trails. Comparing subjects using the reflex with those not doing so, stretch reflex control resulted in less swaying. The 5 subjects using reflex controls oftentimes swayed more [2]. Several previous studies by similar task have postulated that the stabilizing responses are primarily of vestibular rather than of proprioceptive origin [3].

Postural tone

A certain level of muscle tone is present in a normal, conscious, and relaxed person to maintain body in balance. In relaxed state no electrical activity is recorded in normal human skeletal muscle using electromyography (EMG). This has led researchers to argue that non-neural contributions to muscle tone

are the result of small amounts of free calcium in the muscle fiber, which cause a low level of continuous recycling of cross-bridges [4]. When we stand upright, activity increases in antigravity postural muscles to counteract the force of gravity. This is referred to as postural tone [5].

Quiet Stance

Researchers have found that some of the muscles tonically active during quiet stance are the soleus and gastrocnemius, because the line of gravity falls slightly in front of the knee and ankle, the tibialis anterior, when the body sways in the backward direction, the gluteus medius and tensor fasciae latae but not the gluteus maximus, the iliopsoas, which prevents hyperextension of the hips, but not the hamstrings and quadriceps and the thoracic erector spinae in the trunk, because the line of gravity falls in front of the spinal column [6]. From the laboratory experiment, the researchers have shown that no one stands absolutely still. The body sways in small amounts, mostly in the forward and backward direction [7]. Recent years, they have begun to focus on mechanisms underlying stability in other directions as well [8].

Early days of postural control research

Early postural control research by Nashner and colleagues explored muscle patterns that underlie movement strategies for balance [7, 9, 10]. Results from postural control research in neurologically intact young adults suggest that the nervous system combines independent, though related, muscles into units called muscle synergy [5]. A synergy is defined as the functional coupling of group of muscles such that they are constrained to act together as a unit. Traditionally, ankle strategy and its related muscle synergy were among the first patterns for controlling upright sway. Nashner reported motion of the platform in the backward direction causes the subject to sway forward [7]. Muscle activity begins at about 90 to 100msec after perturbation onset in the gastrocnemius, followed by activation of hamstrings 20 to 30msec and finally by the activation of the paraspinal muscles [11].

Horak and Nashner suggested that the hip strategy is used to restore equilibrium in response to larger, faster perturbations or when the support surface is complaint or smaller [9]. In contrast to AP postural control, ML control of balance occurs primarily at the hip and trunk, rather than at the ankle [12-15]. AP muscle response patterns are organized in a distal to proximal manner while ML muscle patterns are organized in a proximal to distal direction, with hip muscles being activated before ankle muscles [16]. They noted that primary ML motion of the body is lateral movement at the pelvis, which requires adduction of one leg and abduction of the other leg. If width between feet is greater than 8 cm, then motion at the ankle diminishes. Hip abductor and adductor muscle groups are activated in control of the loading and unloading of two legs with ML sway [15-17].

Brain and its connections

The brainstem has important centers for controlling the facilitation through raphe-spinal and coerulospinal tracts and inhibition of muscle tone through the mesopontine tegmentum and the reticulospinal tract important for control of posture. The muscle-tone facilitatiory and inhibitory systems are present within the brain stem [18]. From this we can say that CNS must activate synergistic muscles at mechanically related joints for balance control. CNS organizes sensory information from visual, somato-sensory and vestibular systems for postural control. Muscle response latencies to visual cues signaling perturbations to balance are quite slow (200msc) when compared to somatosensory responses (80 to 100msec) [19].

The upright equilibrium of the freely standing human is maintained by using three independent sensory sources from (Figure 1) somatosensory, vestibular inputs, and vision [20]. In their study normal young children ranging in age from 1½ to 10 years were assessed to find the strategy of control to altered support surface and visual conditions. The experimental protocol used a movable platform and visual surround, and the analytic techniques, using EMGs and measures of reaction forces and body motions. They reported young children below the age of 7½ years were unable to suppress systematically the influence of inputs derived from the support surface or from vision when these provided inappropriate orientation information due to the motion of these surfaces. From this they emphasizes that the automatic postural adjustments and the context-dependent reweighting of support surface, vestibular, and visual inputs are organizationally separate

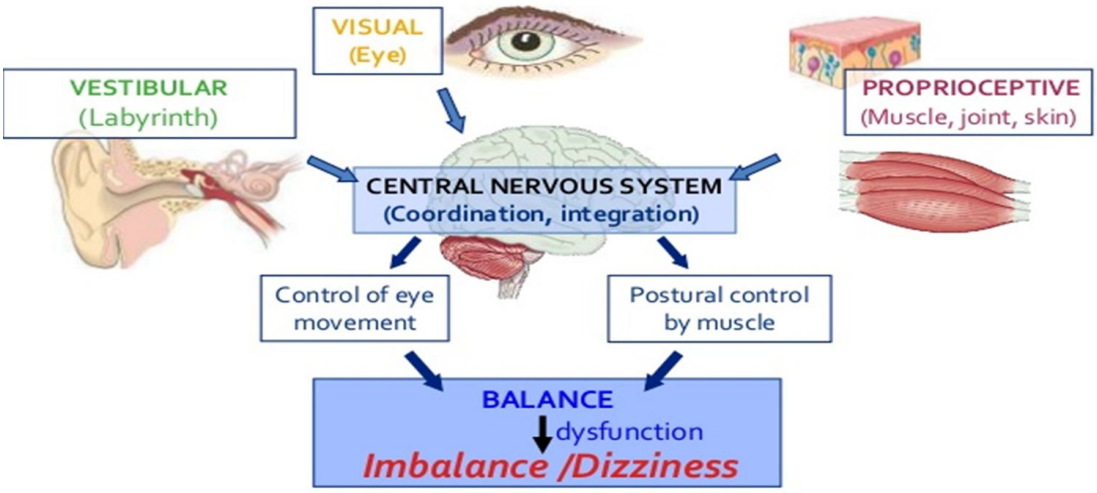

Fig. 1: Somatosensory, vestibular, and visual sensory system interaction

processes and that the hierarchically lower level automatic process matures before the higher level adaptive processes.

Intermodal theory of sensory organization

According to intermodal theory of sensory organization by Stoffregen and Riccio there is no conflict rather all the senses provide information that increases specificity in postural control [21]. There is no relative weighting of sensory information rather orientation emerges from an interaction of all three senses. Intermodal information provides CNS with essential information for postural control. Body sway across the six sensory conditions within a large group of neurologically intact adults reports that the adults sway least in the conditions in which support surface orientation inputs are accurately reporting the body's position in space relative to the surface regardless of the availability and accuracy of visual inputs [22].

Postural sway

A study was done to investigate how postural sway was affected by provocation of vision, by the position of the vestibular organ, and by provocation of proprioception postural sway. Mediolateral (ML) sway does not seem to be influenced by the position of the vestibular organ. Postural sway was measured by using a force plate. Tests were performed with eyes open and eyes closed, with head in neutral position and rotated to the right and to the left and with head maximally extended, both standing on firm surface and on foam. Measures of ML speed (mm/s); anterior-posterior (AP), speed (mm/s), and velocity moment (VM) (mm^2/s) were analyzed using a multilevel approach. The multilevel analysis revealed how postural sway was significantly affected by closed eyes and standing on foam, and by the position of the vestibular organ. Closed eyes and standing on foam both significantly prolonged the dependent measurement, irrespective of whether it was ML, AP or VM. However, only AP and VM were significantly affected by vestibular position [23].

Recent Research

Recent researchers have suggested that there are significant attentional requirements for postural control. These requirements vary depending on the postural task, on the age of the individual, and on the individual's balance abilities [24]. Attention is defined as the information-processing capacity of an individual. Neumann suggested that if two tasks are performed together and require more than the total processing capacity, the performance on either or both will deteriorate [25]. According to systems theory of motor control, a number of different neural and musculoskeletal systems contribute to the emergence of normal balance function in children [26]. These include neural subsystems such as sensory, motor and higher integrative functions and musculoskeletal contributions such as muscle strength, joint range of motion, skeletal alignment and upright posture [27].

Conclusion

Postural control depends upon the superfluous inputs from somatosensory, visual and vestibular systems. Future studies should focus more on assessment of different aspects of postural control and examine its effects on functional balance.

Conflicts of interest: None declared.

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Review Article

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Telerehabilitation: Is Technology-Driven Healthcare an Effective Option for Improving Quality of Life?

Nisha Rani Jamwal*, Senthil P. Kumar**

Abstract

Telerehabilitation (TR) refers to the delivery of rehabilitation services via information and communication technologies. Telemedicine offers an innovative approach to increase access to rehabilitation medicine services for patients who live in areas where healthcare providers are scarce or absent. The objective of this review paper was to highlight the role of TR from an evidence-informed perspective. We searched MEDLINE for English articles and identified abstracts relevant to TR which were synthesized under practice and research in TR with issues in the present and implications for future.

Keywords: Telemedicine; mHealth; Telephone Triage.

Introduction

Telemedicine offers an innovative approach to increase access to rehabilitation medicine services for patients who live in areas where healthcare providers are scarce or absent. Telerehabilitation (TR) refers to the delivery of rehabilitation services via information and communication technologies. The objective of this review paper was to highlight the role of TR from an evidence-informed perspective.

We searched MEDLINE for English articles and identified abstracts relevant to TR which were synthesized under practice and research in TR with issues in the present and implications for future.

Practice of Telerehabilitation

People with disabilities who live in rural communities face challenges accessing healthcare due to their inability to travel long distances to a specialty clinic for necessary expertise due to inadequate or unavailable transportation, disability specific limitations, and financial limitations (Parmonto and Saptono, 2009).

Telerehabilitation was used by physical therapists, occupational therapists, speech and language pathologists, audiologists, recreational therapists, neuropsychologists, nurses, other physician specialists, and physiatrists (Gregory et al, 2011). Brennan et al (2010) emphasized that TR encompasses a range of rehabilitation and habilitation services that include assessment, monitoring, prevention, intervention, supervision, education, consultation, and counseling, across many points of service, such as health care settings, clinics, homes, schools, or community-based worksites.

TR aimed at enhancing quality of life should adequately address the supposedly advantageous routine face-to-face care such as; interventions were delivered in the natural environment, efficacy through individualization of care, increasing patient participation, including environmental context in rehabilitation, and increasing patient satisfaction (McCue et al, 2010). Brennan and Barker (2008) explained the importance of human factors in developing and implementing TR programs that they should address: factors such as age, education and technology experience; accommodating a range of potential patient impairments, including deficits in language, cognition, motor function, vision and voice; adherence to universal design standards to improve accessibility, efficiency, usability and end user understandability.

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Research in Telerehabilitation

Rogante et al (2010) aimed to describe the ten-years state-of-the-art literature by searching five databases and found 146 scientific articles of which 56 articles focused on patient treatment, 23 are reviews, 3 were to be considered as both patient treatment papers and reviews, 53 are either technical reports, system descriptions or analyses of new approaches; and 8 were general discussion on telerehabilitation.

Hailey et al (2011) searched five databases and reviewed 61 studies on twelve clinical categories of disability, other than mental health conditions, and drug or alcohol addiction and found that 51% studies were of high or good quality of which 71% studies reported that TR applications were successful, 18% unsuccessful and 11% unclear.

Evidence for telerehabilitation had grown in size by the increasing number of systematic reviews, but Rogante et al (2015) found quality-related issues in reporting systematic reviews and they found telerehabilitation was comparable to usual care: (1) in the short term treatment of mental health related to people affected by spinal cord injury; (2) in rural communities for treating patients affected by chronic conditions; (3) in treating common pathologies (mainly asthma) affecting children and adolescents.

Seelman and Hartman (2009) listed the need for future studies in TR as: (a) need for policy as a complement to technology and clinical services; (b) need for outcome studies; (c) need for innovation in health care to meet the needs of the world's burgeoning older adult and disability populations; (d) need for including medical, functional and quality of life factors into studies; and (e) need for a data base of research studies and research tools.

Economical Impact of TR

Dhurjaty (2004) described that, "telerehabilitation had a positive business case with respect to all the stakeholders: patients benefit by getting back to their normal activities faster, both at home as well as work. Telerehabilitation at work allows employees to be treated at work without having to take time to go to a clinic. Lost opportunity costs for employers are minimized when workers return to work faster and are treated onsite. The ability to measure progress quantitatively is beneficial for patients, providers, payers, and employers. Additionally, malingering can be detected and eradicated using telerehabilitation. Proper application of appropriate telerehabilitation technologies makes eminent economical sense. There is a strong business case for the application of telerehabilitation, onsite, in large corporations and therefore is profitable to medical device manufacturers.

Issues in Telerehabilitation

Theodorus and Russell (2008) listed as follows: "(a) licensure and certification across state and national borders; (b) equivalence of international clinical standards; (c) regulation on privacy issues and the access and protection of patient health information; (d) issues on costs and remuneration of services; (e) liability and accountability; and (f) unification of international rules effecting clinical consultations."

Kaplan and Litewka (2008), identified the following policy-related problem areas: "(a) abridgement of privacy by inducing combining and mining data and implications of new technology on informed consent; (b) inaccurate and obsolete data; (c) security breaches; (d) usability and user friendliness; (e) data standards, and integration for linking patient and personal information to achieve interoperability of individual records, personal health management and public health; (f) systems design and deployment decisions; and, (g) trade-offs between social isolation and enhanced care, especially homecare".

Acknowledgments: None

Conflicts of interest: None identified and/or declared.

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A Literature Review on Effects of Adjunct Techniques on Plantar Fasciitis

Himani Chawla*, Manu Goyal, Asir John Samuel***, Senthil Paramasivam Kumar******

Abstract

The literature review on adjunct techniques in plantar fasciitis was aimed to provide an evidence-informed overview to highlight the role of adjunct treatment techniques in plantar fasciitis. Research articles were explored from PubMed and PEDro for dry needling and kinesio taping in plantar fasciitis. This will help in the treatment of plantar fasciitis and to improve the foot function in an effective way in short duration. More high quality research articles are needed to prove the efficacy of adjunct techniques in plantar fasciitis.

Keywords: Intra Muscular Manual Therapy; Rehabilitative Taping; Plantar Heel Pain; Podiatric Rehabilitation; Soft Tissue Injuries.

Introduction

Plantar Fasciitis (PF) is the most common and disabling musculoskeletal pathology of foot. Plantar fasciitis is an overuse condition that results from repeated micro trauma to the Plantar Fascia at its attachment to the calcaneus, and it is due to collagen disarray in the absence of inflammation. Thus, the pathology resembles that of tendinosis [1]. It is estimated that 10 in 100 people are affected by PF at some point during their life span. Middle aged and older adults are predominantly affected and it is more common in women [2]. PF accounts for about 8-15% of the total foot complains in non-athletic and athletic populations [3].

Although PF is known to be idiopathic there are certain risk factors such as obesity, sedentary life style, occupations which require prolong standing, long distance running and limited dorsiflexion at ankle joint due to calf muscle tightness [2]. The existing literature attributes plantar fasciitis to the involvement of myofascial meridians [4, 5]. As the fascial connective tissue is a continuous system; the tightness or myofascial dysfunction of the posterior muscles of leg alters the stress on plantar fascia [6].

Conservative management addressing myofascial dysfunction in plantar fasciitis includes Medical management which consists of Relative rest, NSAIDs and Corticosteroids [7]. Physiotherapy is a preferred treatment which aims at alleviating pain and restoring mechanical function [8]. Existing Physiotherapy management includes icing, stretching of gastrocnemius muscle and plantar fascia, strengthening of intrinsic foot muscles, taping, myofascial release (MFR), shoe inserts, manual mobilization to ankle joint complex, night splints, iontophoresis, therapeutic ultrasound [7, 9].

Adjunct techniques of dry needling and Kinesio taping are increasingly used for the treatment of myofascial dysfunctions by physical therapists. In this study we explored the research articles from PubMed and PEDro for dry needling and kinesio taping in plantar fasciitis.

Adjunct techniques and plantar fasciitis

Cotchett et al [10] conducted a parallel-group, participant-blinded, randomized controlled trial to evaluate the effectiveness of dry needling for plantar heel pain. 84 patients with heel pain of at least 1 month's duration were randomly assigned to receive real or sham trigger point dry needling; with one

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treatment per week for 6 weeks and were followed for 12 weeks. They concluded that dry needling provided statistically significant reductions in plantar heel pain, but the magnitude of this effect should be considered against the frequency of minor transitory adverse events.

Akhbari et al [4] conducted a case report to describe the use of dry needling based on myofascial meridians for management of plantar fasciitis. A 53 year old man with bilateral chronic plantar fasciitis of more than 2 years; initial examination revealed that multiple trigger points were found along the insertion of Achilles tendon, medial gastrocnemius, biceps femoris, semimembranosus and ischial tuberosity and dry needling of trigger points was applied; after 4 treatments over 2 weeks the patient felt a 60% to 70% reduction in pain and his pressure pain threshold was increased. Thus, they concluded that dry needling to additional locations along superficial back line suggests that a more global view on management of plantar fasciitis was beneficial for that patient.

Tsai et al [11] conducted a randomized controlled trial to investigate the therapeutic effects of kinesio taping on plantar fasciitis. 52 patients with PF were randomly allocated to two groups; control group received only a traditional physical therapy program daily, including ultrasound thermotherapy and low-frequency electrotherapy; experimental group received kinesio taping of gastrocnemius and plantar fascia in addition to the same physical therapy program as the control group continuously for one week and they noted the reduced pain scores and the reduced thickness of plantar fascia at the insertion site after treatment were significantly more in the experimental group than in the control group. Thus, they concluded that the additional treatment with continuous kinesio taping for one week might alleviate the pain of plantar fasciitis better than a traditional physical therapy.

Discussion

The available physiotherapy treatment for plantar fasciitis takes long duration to alleviate symptoms. For greater improvement in shorter duration, the addition of dry needling and kinesio taping to existing physiotherapy treatment can be effective in reduction of symptoms in patients with plantar fasciitis. Limitation of this review is lack of systematic review and lack of clinical trials.

Conclusion

During this literature review we found that how adjunct techniques are effective in the treatment of plantar fasciitis; but there are only two PubMed and one PEDro indexed researches are published till date. The intention of this review is focused to emphasize the researches for treatment of plantar fasciitis with adjunct techniques in future; so that plantar fasciitis can be treated in a effective way in short duration.

Conflict of interest

None identified and / or declared

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