Journal of Advances in Medicine and Medical Research

Volume 35, Issue 14, Page 72-76, 2023; Article no.JAMMR.99726
ISSN: 2456-8899
(Past name: British Journal of Medicine and Medical Research, Past ISSN: 2231-0614, NLM ID: 101570965)

Decreased Mood Correlated with Decreased Exercise Adherence and Increased Pain

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JAMMR/2023/v35i145057

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/99726

Original Research Article

Received: 07/03/2023
Accepted: 09/05/2023
Published: 20/05/2023

ABSTRACT

Background: A home exercise program is an important part of recovery from musculoskeletal injuries and can improve pain, quality of life, and self-efficacy. However, there are often challenges with patient adherence and measuring compliance. Mood and pain can have a positive and negative affect on a patient's adherence and performance. Digital health, such as Recupe, provides an opportunity to examine the relationship between pain, mood, and exercise adherence outside the clinic.
Methods: A total of 864 subjects were retrospectively analyzed to assess mood and reps completed per session, mood and time spent exercising per session, and mood and pain level. Mood was measured using three categories: "Happy," "Neutral," and "Sad." Pain was measured using the Numerical Pain Rating Scale (NPRS) of 0-10.
Results: The subject population included 331 males, 359 females, and 174 not stated. The average reps completed per session was 218.2 (130.0) for the "Happy" group, 163.3 (101.4) for the

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"Neutral" group, and 140.0 (95.7) for the "Sad" group with p-values <0.0001 between all groups. The average time spent exercising per session were 29.54 minutes (24.63) for the "Happy" group, 21.80 minutes (18.30) for the "Neutral" group, and 22.31 minutes (21.23) for the "Sad" group with p-values <0.0001 between all groups. Lastly, the average pain level for each mood was 1.93 (1.69) for the "Happy" group, 4.4 (1.82) for the "Neutral" group, and 6.1 (2.00) for the "Sad" group with p-values <0.0001 between all groups.

Conclusion: There is a significant correlation between mood, reported pain levels, and adherence to the patients' exercise programs. Patients who report higher pain levels, simultaneously report more depressed moods and demonstrate decreased exercise times and repetition counts. Yet, while this correlation is clear, the causation factor is not known and requires more research. Clinicians should look to observe this pattern in patients to possibly improve recovery.

Keywords: Mood; physical therapy; exercise adherence; orthopedics; digital health.

1. INTRODUCTION

Physical therapy is a key to the recovery from musculoskeletal injuries, resulting in good patient satisfaction [1]. Combined with in-person office visits, home exercise plans are an important part of this recovery [2,3]. Research supports the use of these home exercises and educational-based programs as they relate to a person's improved pain level, quality of life and self-efficacy [4]. However, there are many challenges, with adherence to a prescribed plan being one of the greatest [5].

Adherence is commonly measured by having clinicians ask patients for a verbal report, or recorded in a log. However, both have been shown to have poor reliability [6,7]. Non-adherence has been estimated to be as high as 70% in patients [8].

Other challenges to home exercises can be the patient's confidence in their ability to perform the exercise, [9] and perhaps their own health beliefs [10]. These challenges can be mitigated by different types of instruction with videos, [11] and digital health methods showing good patient performance [12].

A patient's mood can also affect their performance. When completing a physical therapy exercise program, an improved, happier mood could increase adherence, focus on goals, and improve progress, leading to improved functional outcomes [13,14]. Conversely, poor mood and high pain can lead to decreased adherence and poor outcomes [13]. Finally, mood can be affected as well, as physical therapy and activity can reduce pain and improve mood [13,15,16].

One method to measure and ensure exercise adherence outside of office visits is through wearable tracking sensors. Plethy, who is committed to the APTA Digital Health Transparency Campaign, offers this solution through their Recupe app and sensor. Augmenting healthcare providers, Recupe gives patients clinician directed, remote supervised rehabilitation with a record of the data from their home exercise sessions. This holds patients accountable to their healthcare provider for rehab performed without in-person supervision. ROM is captured from the sensor as well and found to be over 90% accurate [17]. Utilizing Recupe throughout a patient's rehabilitation journey provides a customized exercise and education program that works to optimize recovery leading to improved outcomes across the board.

This retrospective study examines the relationships between mood, pain, and exercise adherence in digital health patients using the Recupe platform for recovery from various musculoskeletal conditions.

2. METHODS AND PROCEDURES

Subjects were drawn from the Plethy database from dates ranging from 08/27/2018 to 05/01/2022. Patients who were on the Plethy program for 7 days or less were filtered out. Then, any session times longer than 100 minutes were truncated to 100 minutes.

At the beginning of each session, patients would be asked to report their mood by selecting one of 3 face emojis representing Happy, Neutral, and Sad. Pain was reported using the NPRS scale before starting exercises.

Patients would perform two exercise sessions per day, with slow controlled reps. Total exercise time was captured from the app. Reps were calculated by combining data collected by a wearable sensor with patient reporting on the app.

The total population included 864 subjects separated into the following demographics.

3. RESULTS

The following were the results from the selected population.

3.1 Time Spent Exercising per Session - Minutes

For exercise sessions times were capped at 100 minutes to account for the possibly of people leaving a session running on their app as they left to do other activities.

3.2 Pain

Information regarding pain levels was also collected using the Recupe application. Pain levels for each patient were recorded on a Numerical Pain Rating Scale (NPRS) of 0-10. The results are as follows: in Tables 1-6.

Table 1. Gender wise distribution

Male	331
Female	359
Not Stated	174

Table 2. Age related distribution among male and female

	Average age	Standard deviation
Male	57.97	15.59
Female	60.68	16.3
Not Stated	52.95	15.66

Table 3. Time related distribution among male and female

	Average time	Standard deviation
Male	80.12	63.44
Female	77.36	60.00
All Population	77.96	60.97

Table 4. Emotional aspect among respondents (age wise)

	Happy	Neutral	Sad
Average	218.2	163.3	140.0
Standard deviation	130.0	101.4	95.7

P-values between all groups were less than 1.0 E-8

Table 5. Emotional aspect among respondents (time wise)

	Happy	Neutral	Sad
Average	29.54	21.80	22.31
Standard Deviation	24.63	18.30	21.23

P-values between all groups were less than 1.0 E-22

Table 6. Data statistics results

	Happy	Neutral	Sad
Average	1.93	4.4	6.1
Standard Deviation	1.69	1.82	2.00
Average Age	58.53	58.31	58.43
Standard Deviation	15.37	15.66	15.23
Percentage Female	50.26	53.23	59.23
Percentage Male	49.73	46.31	40.76

P-Values for pain between all groups were less than 1.0 E-181

4. DISCUSSION

The results above show statistically significant correlation between mood, reported pain levels, and adherence to the patients' exercise programs. Those patients who report higher pain levels, simultaneously report more depressed moods as well as demonstrate consistently decreased exercise times and repetition counts. This shows a correlation between pain and mood, as pain and mood are inversely related. What cannot be known is if pain creates a poor mood or if a poor mood increases the sensation of pain, as pain is a purely subjective measure. Still, with the decreased exercise time and repetitions with poor mood, it appears that emotional wellness is a key part of home recovery, and so should be a part of all home programs. Unfortunately, emotional or mental health measurements are not commonly tracked during physical therapy.

Conversely, for patients who reported lower pain levels, they also reported improved moods and significantly increased exercise times compared to the "Sad" group. These patterns were expected as research has shown decreased moods and levels of self-efficacy create barriers to treatment adherence with physical therapy [18].

Further research is required to determine if adherence results in lower pain and mood, or if there is a different cause for these correlations.

When looking at the demographics, the average age was recorded as about the same for all mood categories. This shows that there is no direct correlation between age, mood, and pain. Relating to gender, the most significant correlation was that more females recorded “Sad” much more often than males, and “Neutral” slightly more. Research suggests that when reporting higher levels of depression, women also report higher levels of disability [19]. This higher level of disability could affect their ability to perform exercises.

Utilizing a digital health platform that provides these insights, such as Recupe, will aid clinicians as they assist patients through recovery. Mood data can be recorded daily, rather than limited to office visits, creating more opportunities for early intervention. Recupe assigns coaches to monitor each patient, so any mood concerns can be quickly shared with the treating provider.

5. CONCLUSION

In summary, the higher a patient’s pain level is, the more depressed their mood tends to be, and the less likely they are to complete their physical therapy exercises. So, those who could benefit most from therapy are least likely to do their therapy, likely resulting in poorer outcomes. While this correlation is clear, the causation factor is not known and requires more research. Still, when this pattern is observed in these patients, mitigation steps can be taken to likely produce improved recovery. Also, with females reporting higher levels of depression, being at more risk of disability, additional attention should also be paid to coaching females through their rehabilitation programs as well. With digital health, such as Recupe, faster intervention can be provided for all these potential concerns.

6. IMPACT STATEMENT

Tracking mood may be beneficial for maximizing recovery as decreased mood appears to be correlated with increased pain and decreased exercise adherence. Longer recovery times can result from decreased exercise adherence. Time is key to these mitigations

7. LIMITATIONS

Some weakness of this study are the lack of a control group. Also, mood measurements are not required for use of the exercise program, so measurements were not taken at every session. These weaknesses were mitigated by the sample size.

CONSENT

As per international standard or university standard, patient(s) written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

Study IRB approval and Conflict of Interest review have been completed through BRANY. The Principal Investigator/lead author is an employee of Plethy. Need for informed consent waived by BRANY’s ethics review. All funding was through Plethy.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/99726