

Compliance with remotely monitored physical therapy is higher in the older age group and for treatment of the upper extremity

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Background: Remotely monitored physical therapy (RMPT) has emerged as an efficacious and cost-effective alternative to in-office physical therapy. These platforms enable real-time progress tracking, adjustments to patient care plans, and provide feedback to motivate patients to improve their health status. However, little data is available with regards to compliance which may vary based on age given the technology required for use.

Purpose: To evaluate compliance with RMPT in different age groups across different body regions. Our hypothesis was that elderly patients would demonstrate similar compliance to younger patients with an RMPT program.

Methods: A consecutive series of patients that underwent RMPT from Jan. 2022 to Jan. 2024 at 8 institutions were selected for the study. Compliance was stratified as low (<33% completion of exercises), moderate (33-66% completion of exercises), or high (>66% completion of exercises). Data collected included demographic data, body region (upper extremity, lower extremity, or spine), compliance and duration of RMPT.

Results: A total of 2019 patients with an average age of 61.7 ± 12.9 years and rehabilitation duration of 23.7 ± 5.8 weeks were included in this analysis. Among these, 1735 (85.9%) underwent RMPT for the upper extremity, 244 (12.1%) lower extremity condition, and 40 (2%) for a spine condition. Compliance increased with advancing age ($p < 0.001$). High compliance was seen in 23.7% of the upper extremity cohort, compared to 15.6% in the lower extremity cohort and 7.5% in the spine cohort ($p = 0.002$). Overall, compliance rates were moderate or high in 66% of patients.

Conclusion: Despite requiring familiarity with technology, older patients demonstrate improved compliance with RMPT compared to younger patients. Compliance also appears to vary by body region with the highest compliance seen for the upper extremity and lowest compliance seen for the spine.

What this study adds: This study demonstrates that older adults exhibit higher compliance rates than younger individuals. Clinically, this study supports the integration of RMPT into routine physical therapy practice, particularly for older patients and those with upper extremity conditions.

Potential impacts on research, practice, or policy: This study highlights the potential for RMPT to enhance compliance among older adults, challenging traditional assumptions about technology adoption in this demographic. These findings may inform healthcare policies aimed at improving patient engagement and accessibility in older adults.

Study Design: Retrospective Case Series

Level of Evidence: Level 4

Keywords: Remotely monitored physical therapy; Physical Rehabilitation; Gamification; Compliance; Older adults

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Introduction

Physical therapy (PT) plays a major role in the outcomes of orthopedic care [1]. Among patients with chronic musculoskeletal conditions, regular PT is instrumental in preserving physical function and alleviating symptoms of pain. Consistent physical activity facilitated by PT not only

helps manage osteoarthritis but also positively impacts the progression of various chronic diseases [2][3]. Once conservative treatment fails to treat pain, surgical intervention may be required and post-operative PT is critical to success and a differentiating factor in patient recovery [4].

With this important role, the demand for PT in orthopedic care has been said to only increase. Studies have shown

upwards of 3 million annual visits for chronic musculoskeletal pain in young adults alone, with numbers rising with increased age [5]. Similarly, the number of same-day orthopedic surgeries has doubled in recent years, and it has been estimated that by 2030, the demand for joint arthroplasty's will increase by up to 673% [6][7]. The increase in same day surgeries, has also shifted immediate postoperative PT from the hospital to the home or in-office. One significant and persistent challenge in the field is the limited availability of PT services, which is partly due to a shortage of qualified professionals. Research indicates that the current number of therapists is insufficient, falling short of patient demand by approximately 10% to 20%. This workforce deficiency presents a substantial barrier to healthcare systems striving to improve the delivery of care provided by physical therapists [8].

Despite its importance, patient compliance with PT can be variable and multifactorial. Financial limitations due to health insurance reimbursements, lack of access to providers and facilities, transportation costs and long waiting lists all contribute [9][10]. Moreover, most PT facilities provide services only during business hours leading to missed work days and further increasing patient out of costs.

To combat these challenges, remotely monitored physical therapy (RMPT) has been developed and tested over the last few years. RMPT enables real-time progress tracking, adjustments to patient care plans, and feedback to motivate patients to improve their health status. Most importantly, it has emerged as an efficacious and cost-effective alternative to in-office PT [11][12][13][14]. Moreover, RMPT may enhance compliance in patients who have difficulty in attending in-office visits due to distance, disability, or work constraints. Lastly, it has shown to reduce hospital associated costs, length of stay and rehospitalization [15].

While compliance with traditional in-person PT has been studied, little data is available regarding compliance with RMPT. The purpose of this study was to evaluate compliance with RMPT in different age groups across different body regions. We hypothesized that elderly patients would demonstrate similar compliance to younger patients with an RMPT program and that compliance would be similar across different body regions.

Methods

Study patients

A retrospective review was performed on a consecutive series of patients that were prescribed RMPT as part of their care plan from January 2022 to January 2024 across 8

different institutions. To mitigate the risk of selection bias, we included all qualified participants who enrolled in RMPT during this timeframe.

The inclusion criteria were a surgical and non-surgical orthopedic condition requiring PT, >18 years old, and use of the RMPT application on a smart device with an active email address.

The exclusion criteria were in-office PT treatment and non-orthopedic conditions.

Compliance with PT exercises was stratified into three different groups. (1) low (<33% completion of exercises) (2) moderate (33-66% completion of exercises) (3) high (>66% completion of exercises). Patients were categorized into three body region groups: upper extremity (total and reverse shoulder arthroplasty, shoulder arthroscopy, rotator cuff repair, biceps tenodesis, and labral repair), lower extremity (total knee arthroplasty, knee arthroscopy, and total hip arthroplasty), and spine (post-laminectomy syndrome and degenerative lumbar conditions).

RMPT Application

Patients were offered RMPT via their smart devices regardless of age and were provided a weekly plan with daily exercises until discharge from PT. The Genie Health RMPT app was used by all patients in this study. The app consists of both a patient facing instance (mobile app), that is available on both iOS and Android devices, as well as a provider portal (web portal), that is accessible via a desktop computer. The patient app enables the users to see their prescribed exercises daily, communicate with their care team, and conduct telehealth calls on regular basis. Once downloaded, the app will monitor and track the patient rehab exercises via the front-facing camera of the smart device, utilizing marker-less motion capture technology. The data generated by the users gets securely pushed to the provider portal, which ultimately enables the care team to check on the rehab progress, modify the plan of care and promptly communicate with the users. The application does not require the use of any additional hardware and can be used on many smart devices that have access to Wi-Fi.

Data and Outcomes

Baseline data collection included patient age, gender and BMI. To measure the outcomes of the study, data collection for each patient included the body region for which RMPT was prescribed (upper extremity, lower extremity, or spine), number of prescribed exercises, number of completed exercises, duration of RMPT, and visual analog scale (VAS) for pain at the initiation and completion of each session. Patient compliance was calculated by dividing the number of

exercises completed and number of exercises prescribed. Compliance data was automatically recorded by the RMPT application, which tracked patient engagement in real time. Each session required the user to initiate the exercise, complete the prescribed movements, and log pain levels before and after. The app continuously monitored completed and missed exercises, allowing for the generation of weekly and monthly compliance rates. The automated data collection allowed us to avoid self-reporting minimizing biases. Patients consented for their data to be collected prior to using the Genie Health application. The data collection was automatically de-identified through the app and stored in a secure database. The data collection done was not for any specific project as well. These parameters gave us exemption from IRB approval in accordance with the NIH decision tool.

Statistical Analysis

Descriptive statistics were performed on patient demographics. Comparison of the categorical variables (gender, age groups and body regions) were performed using Chi-square tests. The data was recorded as mean $\pm$ standard deviation for all continuous variables. All statistical analyses were performed using SPSS, version 27 (IBM, Armonk, NY, USA). $P < 0.05$ was considered significant for all comparisons.

Results

A total of 2019 patients were included in this study. Participants had an average age of 61.7 ± 12.9 years and

underwent an average rehabilitation duration of 23.7 ± 5.8 weeks (**Table 1**). From the 2019 patients, 1109 (54.9%) were males and 910 (45.1%) were females. No statistically significant difference was seen based on gender among all three compliance groups ($p=0.446$) (**Table 2**).

There was a statistically significant difference in compliance between different age groups ($p < 0.001$). Patients <50 years had the highest proportion of patients with low compliance, and this decreased as age advanced (50.2% in <50 to 26.4% in >70). Conversely, patients demonstrating moderate and high compliance increased as patients got older (39.4% in <50 to 44.9% in >70 & 10.5% in <50 to 28.7% in >70) (**Table 3**).

From the 2019 patients, 1735 (85.9%) underwent RMPT for the upper extremity PT, 244 (12.1%) underwent treatment for a lower extremity condition, and 40 (2%) underwent treatment for spine condition. Chi-square analysis among the different body regions showed a statistically significant difference between compliance rates ($p = 0.002$). Upper extremity rehabilitation had the most patients with high compliance (23.7%) and spine with the least (7.5%). As for low compliance, the lower extremity demonstrated the most patients within this group (41.4%), while the upper extremity demonstrated the least (32.9%) (**Table 4**).

When combining all body regions, the study demonstrated an overall exercise compliance of $46.4\% \pm 23.0$, and a mean compliance of $21.5\% \pm 6.2$, $48.9\% \pm 9.8$ and $79.5\% \pm 8.6\%$ for each compliance group (**Table 5**).

Table 1: Patient demographics

Patient demographics	
Number of patients	2019
Age	61.7 ± 12.9
<50	325 (16.1%)
50-60	485 (24.0%)
61-70	686 (34.0%)
>70	523 (25.9%)
Gender	
Male	910 (45.1%)
Female	1109 (54.9%)
Body Region	
Upper Extremity	1735 (85.9%)
Lower Extremity	244 (12.1%)
Spine	40 (2.0%)
Follow up duration	23.7 ± 5.8 weeks

Table 2: Gender and Compliance

Gender	Total N (%)	Exercise Compliance			P-value
		Low Compliance (<33%)	Moderate Compliance (33-66%)	High Compliance (>66%)	
Females	910 (45.1%)	320 (35.2%)	194 (21.3%)	396 (43.5%)	0.446
Males	1109 (54.9%)	366 (33.0%)	259 (23.4%)	484 (43.6%)	
Total (%)	2019	686 (34.0%)	453 (22.4%)	880 (43.6%)	

Table 3: Age groups in relation to compliance

Age Groups	Total N (%)	Exercise Compliance			P-value
		Low Compliance (<33%)	Moderate Compliance (33-66%)	High Compliance (>66%)	
<50	325 (16.1%)	163 (50.2%)	128 (39.4%)	34 (10.5%)	<0.001
50-60	485 (24.0%)	196 (40.4%)	190 (39.2%)	99 (20.4%)	
61-70	686 (34.0%)	189 (27.6%)	327 (47.7%)	170 (24.8%)	
>70	523 (25.9%)	138 (26.4%)	235 (44.9%)	150 (28.7%)	
Total (%)	2019	686 (34.0%)	880 (43.6%)	453 (22.4%)	

Table 4: Body region in relation to compliance:

Body Region	Total N (%)	Exercise Compliance			P-value
		Low Compliance (<33%)	Moderate Compliance (33-66%)	High Compliance (>66%)	
Upper Extremity	1735 (85.9%)	571 (32.9%)	752 (43.3%)	412 (23.7%)	0.002
Spine	40 (2.0%)	14 (35.0%)	23 (57.5%)	3 (7.5%)	
Lower Extremity	244 (12.1%)	101 (41.4%)	105 (43.0%)	38 (15.6%)	
Total (%)	2019	686 (34.0%)	880 (43.6%)	453 (22.4%)	

Table 5: Overall compliance

	Mean	Min.	Max.
Overall Exercise Compliance	46.4% ±23.0%	8.7%	100%
25th Percentile	26.3%		
50th Percentile	44.6%		
75th Percentile	64.3%		
Compliance by groups	Mean	Min.	Max.
Low Compliance <33%	21.5%± 6.2%	8.7%	32.4%
Moderate Compliance 33-66%	48.9% ± 9.8%	32.5%	66.5%
High Compliance >66%	79.5% ± 8.6%	66.6%	100.0%

Discussion

The most important finding of the current study was that there is overall high compliance with RMPT is seen among older adults and compliance actually increases as age advances. Additionally, compliance with RMPT varies significantly by the body region being treated, with the highest compliance being in upper extremity rehabilitation. These findings provide valuable insights into the utilization of RMPT across different demographics and anatomical focuses.

Elderly patients often face barriers such as high healthcare costs and the physical challenges associated with frequent travel to medical facilities [16]. The increasing acceptance and utilization of RMPT among older age groups defies conventional assumptions about technology adoption in the elderly. This difficulty in adoption has been seen in previous studies that focused on implementing remote monitoring into patient care. In a 2019 study Correia et al. used digital rehabilitation for the post-operative management of TKA, and reported a higher dropout rate among elderly participants, with seven out of thirty patients discontinuing within the first

week and 60% of the remaining patients requiring caregiver assistance, highlighting the challenges faced by this demographic in adopting digital health solutions [17]. In a study of RMPT after total joint arthroplasty DeFrance et al. indicated that individuals aged 60-69 were four times more likely to use remote monitoring devices post-operatively compared to those aged 80+, suggesting decreased acceptance levels as age advances [18]. Interestingly, the RMPT in both of these studies required some form of a physical bio tracker on the body. The mobile application used in our study removes this barrier by leveraging the precise tracking abilities of artificial intelligence, creating a more user-friendly version for the elderly. It is possible that this technology simplified the adoption for older patients in the current study. It is also notable that our series began in 2022 and is post-COVID which substantially increased the familiarity with remote services. Another factor influencing compliance is real-time monitoring by the healthcare team. The RMPT provider dashboard enables staff to identify missed sessions and reach out to patients, likely improving adherence. While this study did not specifically measure the impact of direct outreach, the ability of rehab specialists to intervene in real time may contribute to higher compliance

rates. We believe this data suggests that RMPT has the potential to enable patients to receive effective PT from the comfort of their homes, thus reducing both financial and logistical burdens.

The importance of compliance and consistency with a rehabilitation program is a well-documented predictor of outcomes in orthopedics [19][20]. As for RMPT, previous work has focused on establishing the effectiveness of RMPT when compared to traditional in-office rehabilitation. However, to our knowledge, this study is the first to attempt to understand compliance with RMPT across multiple body regions. We observed an overall 2-year compliance of 46.4% $\pm$ 23.0, with the upper extremity rehabilitation demonstrating the most patients with high compliance (23.7%). Overall, compliance rates were moderate or high in 66% of patients. Previous literature has shown mixed results when assessing patient compliance with RMPT. Wither et al. assessed the effectiveness of RMPT for various MSK conditions and noted an overall poor compliance, with only 50% of participants practicing two or more exercises on 3 days in week 1 and to 1 day in week 2 [21]. On the other hand, Nuevo et al. reported higher compliance with RMPT (85.99 $\pm$ 19.48%) compared to in-office therapy (59.78 $\pm$ 29.78%) [22]. We believe that the compliance seen in this study is a reflection of the ability to continuously monitor, provide real-time feedback, make continuous adjustments and directly communicate with the patient. All these being reported as key factor for patient compliance [8][9][10]. As for the variability in compliance seen towards different body regions, we suspect early weight bearing protocols and a higher physiological demand in lower extremity rehabilitation may play a significant role.

The measurement of compliance towards unsupervised rehabilitation has always remained a challenge [23]. Previous literature on unsupervised PT programs have reported varying compliance rates ranging from 35%-97%, all which relied on self-reported data [24][25][26]. These studies often suffer from recall bias and overestimations, leading to inaccurate compliance rates. RMPT opens the capability of obtaining objective compliance data, providing an accurate representation of the true compliance. Allowing physicians to understand the variability in their patient outcomes and make accurate changes to their care accordingly.

This study does not come without its limitation. First, the reliance on data collection via the Genie Health app introduces the variable of adherence to the app itself, potentially impacting the accuracy of compliance measurements. Second, while our study population included a substantial number of patients, the distribution of patients across different body regions was uneven, particularly for spine conditions, which had a relatively small sample size.

Third, the study lacked information on outcomes of compliance. Future studies will focus on having a more balanced population, understanding the reduction in pain over time for different body regions and the geographical locations of patients benefiting from RMPT. Lastly, another limitation is the lack of data on socio-economic factors, which may influence compliance. Patients with limited access to smart devices, lower digital literacy, or financial constraints might have different compliance rates compared to those with higher socio-economic status. Future studies will use the area deprivation index as a metric for socio-economic determinants to understand its role in RMPT compliance.

Conclusion

Despite requiring familiarity with technology, older patients demonstrate improved compliance with RMPT compared to younger patients. Compliance also appears to vary by body region with the highest compliance seen for the upper extremity and lowest compliance seen for the spine. These findings suggest that RMPT is a promising option for patients to perform physical therapy from home, regardless of age. Further work may be needed to improve compliance based on body region.

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Conflicts of interest

Patrick J Denard: Arthrex, Inc.: consultation, travel and lodging, faculty and speaker, feed and beverage, royalty and license (This includes Steelhead); Research support Arthrex Inc; Stock ownership PT Genie (Genie Health); Consultant LifeNet; Paid Speaker Pacira. Reuben Gobezie: Arthrex, Inc.: consultation, travel and lodging, faculty and speaker, feed and beverage, royalty and license; Research support Arthrex Inc; Stock ownership PT Genie (Genie Health).

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References

1. Di Fabio RP, Boissonnault W. Physical therapy and health-related outcomes for patients with common orthopaedic diagnoses. *J Orthop Sports Phys Ther.* 1998 Mar;27(3):219–30. DOI: 10.2519/jospt.1998.27.3.219
2. Conn VS, Hafdahl AR, Brown SA, Brown LM. Meta-analysis of patient education interventions to increase physical activity among chronically ill adults. *Patient Educ Couns.* 2008 Feb;70(2):157–72. DOI: 10.1016/j.pec.2007.10.004
3. Esser S, Bailey A. Effects of exercise and physical activity on knee osteoarthritis. *Curr Pain Headache Rep.* 2011 Dec;15(6):423–30. DOI: 10.1007/s11916-011-0225-z
4. Joice MG, Bhowmick S, Amanatullah DF. Perioperative Physiotherapy in Total Knee Arthroplasty. *Orthopedics.* 2017 Sep 1;40(5):e765–73. DOI: 10.3928/01477447-20170518-03
5. Feldman DE, Nahin RL. National Estimates of Chronic Musculoskeletal Pain and Its Treatment in Children, Adolescents, and Young Adults in the United States: Data From the 2007–2015 National Ambulatory Medical Care Survey. *J Pediatr.* 2021 Jun;233:212–219.e1. DOI: 10.1016/j.jpeds.2021.01.055
6. Patel A, Pavlou G, Mújica-Mota RE, Toms AD. The epidemiology of revision total knee and hip arthroplasty in England and Wales: a comparative analysis with projections for the United States. A study using the National Joint Registry dataset. *Bone Jt J.* 2015 Aug;97-B(8):1076–81. DOI: 10.1302/0301-620X.97B8.35170
7. Inacio MCS, Paxton EW, Graves SE, Namba RS, Nemes S. Projected increase in total knee arthroplasty in the United States - an alternative projection model. *Osteoarthritis Cartilage.* 2017 Nov;25(11):1797–803. DOI: 10.1016/j.joca.2017.07.022
8. Hack LM, Coulson B, Freburger J, Johnson MP, Katz RS, Kerwin JP. A model to project the supply and demand of physical therapists 2010–2025. *Am Phys Ther Assoc.* 2017;
9. Carvalho E, Bettger JP, Goode AP. Insurance Coverage, Costs, and Barriers to Care for Outpatient Musculoskeletal Therapy and Rehabilitation Services. *N C Med J.* 2017;78(5):312–4. doi: 10.18043/ncm.78.5.312
10. Dew A, Bulkeley K, Veitch C, Bundy A, Gallego G, Lincoln M, et al. Addressing the barriers to accessing therapy services in rural and remote areas. *Disabil Rehabil.* 2013 Aug;35(18):1564–70. DOI: 10.3109/09638288.2012.720346
11. Fisher C, Wysin C, Moeller L, Nguyen J. Scaled TelePhysical Therapy Program a Promising Option for Post-acute Care of Lower-Extremity Arthroplasty Patients. *HSS J Musculoskelet J Hosp Spec Surg.* 2024 Feb;20(1):41–7. DOI: 10.1177/15563316231210865
12. Marley WD, Barratt A, Pigott T, Granat M, Wilson JD, Roy B. A multicenter randomized controlled trial comparing gamification with remote monitoring against standard rehabilitation for patients after arthroscopic shoulder surgery. *J Shoulder Elbow Surg.* 2022 Jan;31(1):8–16. DOI: 10.1016/j.jse.2021.08.019
13. Pak SS, Janela D, Freitas N, Costa F, Moulder R, Molinos M, et al. Comparing Digital to Conventional Physical Therapy for Chronic Shoulder Pain: Randomized Controlled Trial. *J Med Internet Res.* 2023 Aug 18;25:e49236. DOI: 10.2196/49236
14. Correia FD, Molinos M, Luís S, Carvalho D, Carvalho C, Costa P, et al. Digitally Assisted Versus Conventional Home-Based Rehabilitation After Arthroscopic Rotator Cuff Repair: A Randomized Controlled Trial. *Am J Phys Med Rehabil.* 2022 Mar 1;101(3):237–49. DOI: 10.1097/PHM.0000000000001780
15. Prvu Bettger J, Green CL, Holmes DN, Chokshi A, Mather RC, Hoch BT, et al. Effects of Virtual Exercise Rehabilitation In-Home Therapy Compared with Traditional Care After Total Knee Arthroplasty: VERITAS, a Randomized Controlled Trial. *J Bone Joint Surg Am.* 2020 Jan 15;102(2):101–9. DOI: 10.2106/JBJS.19.00695
16. Hazra NC, Rudisill C, Gulliford MC. Determinants of health care costs in the senior elderly: age, comorbidity, impairment, or proximity to death? *Eur J Health Econ HEPAC Health Econ Prev Care.* 2018 Jul;19(6):831–42. DOI: 10.1007/s10198-017-0926-2
17. Correia FD, Nogueira A, Magalhães I, Guimarães J, Moreira M, Barradas I, et al. Medium-Term Outcomes of Digital Versus Conventional Home-Based Rehabilitation After Total Knee Arthroplasty: Prospective, Parallel-Group Feasibility Study. *JMIR Rehabil Assist Technol.* 2019 Feb 28;6(1):e13111. DOI: 10.2196/13111
18. DeFrance M, Lang J, Aprigliano C, Danoff JR, Nett M. Understanding Patient Perspectives Regarding Remote Monitoring Devices Following Total Joint Replacement. *Arthroplasty Today.* 2023 Feb;19:101056. DOI: 10.1016/j.artd.2022.10.006
19. Edwards P, Ebert J, Joss B, Bhabra G, Ackland T, Wang A. EXERCISE REHABILITATION IN THE NON-OPERATIVE MANAGEMENT OF ROTATOR CUFF TEARS: A REVIEW OF THE LITERATURE. *Int J Sports Phys Ther.* 2016 Apr;11(2):279–301.
20. Hanratty CE, McVeigh JG, Kerr DP, Basford JR, Finch MB, Pendleton A, et al. The effectiveness of physiotherapy exercises in subacromial impingement syndrome: a systematic review and meta-analysis. *Semin Arthritis Rheum.* 2012 Dec;42(3):297–316. DOI: 10.1016/j.semarthrit.2012.03.015
21. Withers HG, Glinsky JV, Chu J, Jennings MD, Starkey I, Parmeter R, et al. Remotely delivered physiotherapy is as effective as face-to-face physiotherapy for musculoskeletal conditions (REFORM): a randomised trial. *J Physiother.* 2024 Apr;70(2):124–33. DOI: 10.1016/j.jphys.2024.02.016
22. Nuevo M, Rodríguez-Rodríguez D, Jauregui R, Fabrellas N, Zabalegui A, Conti M, et al. Telerehabilitation following fast-track total knee arthroplasty is effective and safe: a randomized controlled trial with the ReHub® platform. *Disabil Rehabil.* 2024 Jun;46(12):2629–39. DOI: 10.1080/09638288.2023.2228689
23. Bollen JC, Dean SG, Siegert RJ, Howe TE, Goodwin VA. A systematic review of measures of self-reported adherence to unsupervised home-based rehabilitation exercise programmes, and their psychometric properties. *BMJ Open.* 2014 Jun 27;4(6):e005044. DOI: 10.1136/bmjopen-2014-005044
24. Van Straaten MG, Cloud BA, Morrow MM, Ludewig PM, Zhao KD. Effectiveness of home exercise on pain, function, and strength of manual wheelchair users with spinal cord injury: a high-dose shoulder program with telerehabilitation. *Arch Phys Med Rehabil.* 2014 Oct;95(10):1810–1817.e2. DOI: 10.1016/j.apmr.2014.05.004
25. Kramer JF, Speechley M, Bourne R, Rorabeck C, Vaz M. Comparison of clinic- and home-based rehabilitation programs after total knee arthroplasty. *Clin Orthop.* 2003 May;410:225–34. DOI: 10.1097/01.blo.0000063600.67412.11

26. Alexandre NMC, Nordin M, Hiebert R, Campello M. Predictors of compliance with short-term treatment among patients with back pain. *Rev Panam Salud Publica Pan Am J Public Health*. 2002 Aug;12(2):86–94. DOI: 10.1590/s1020-49892002000800003