Effect of WhatsApp-based reminders on adherence to home exercise program

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Abstract: This study investigated the effectiveness of WhatsApp-based reminders on home exercise program (HEP) adherence. Forty consenting patients [experimental group (EG) (n = 20); control group (CG) (n = 20)] participated in this study. EG received WhatsApp-based reminder messages on HEP thrice weekly for six weeks while CG received no reminders other than therapists' instructions to carry out HEP. Participants recorded their HEP activities on a provided diary, which was monitored weekly. The number of days of adherence was assessed at weeks 3 and 6. There was significant difference in adherence to HEP in EG (6.85 ± 0.37 vs. 19.95 ± 0.89 vs. 20.43 ± 0.69; p = 0.001) and CG (4.50 ± 0.61 vs. 13.50 ± 1.24 vs. 13.95 ± 1.61; p = 0.001) at baseline, 3rd and 6th week, and between EG and CG at weeks 3 and 6 (t = 12.669; p = 0.001). WhatsApp-based reminders significantly improved adherence to HEP among patients receiving physiotherapy.

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1   Introduction

Adherence, which is the extent to which a person's behaviour corresponds with agreed recommendations from a healthcare provider (Horne, 2006), is an important factor which can influence the outcome of the treatment, especially recommendations on home exercise program (HEP) (Beinart et al., 2013; Hayden et al., 2005). HEP is one of the fundamental and important aspects of physiotherapy (Bollen et al., 2014). It involves structured program or activities prescribed with clear objectives for a patient, which should be performed independently or supervised by caregivers at home, with or without monitoring, follow-up visits, letters or telephone calls from staff or at least self-monitoring diaries (Jolly et al., 2006).

Although some patients find HEP to be a burdensome and nuisance, however, completing a home program is fundamental to achieving success in physical therapy (Jolly et al., 2006). Specifically, adherence to HEP has been reported to lead to better treatment outcomes (Svingen et al., 2021; Zapata et al., 2018; Alasfour and Almarwani, 2020) and increase in physical function (Svingen et al., 2021). The concept of adherence to HEP is multi-dimensional (Lambert et al., 2017; Zapata et al., 2018) and poor adherence to home-based rehabilitation or treatment has been identified across many healthcare disciplines including physiotherapy (Campbell et al., 2001). It has been reported that patients generally adhere poorly to their prescribed HEP with varying estimations. Beinart et al. (2013) found that non-adherence to HEP for general musculoskeletal condition represents about 50–65% of all cases. Thus, raising concern for innovative and effective method to reduce patient non-adherence to HEP in physiotherapy.

The use of mobile applications by healthcare professionals (HCPs) has transformed many aspects of clinical practice (Wallace et al., 2012), leading to rapid growth in the development of medical and paramedical software applications (Aungst, 2013; Divali et al., 2013). Currently, mobile applications are being used to promote health (Whitakker et al., 2016), as well as improve adherence to treatment and home program (Lambert et al., 2017) due to their applicability in easy and effective communication (Nicolson et al., 2017).

Smartphone apps have been proven sufficient in providing patients with support in adherence to therapy due to some peculiar features (Zapata et al., 2018; Alasfour and Almarwani, 2020). Evidence from randomised controlled trials have shown that mobile apps help patients with various diseases like stroke, low back pain, pulmonary disease, knee osteoarthritis, fibromyagia, obesity and overweight, diabetes, etc. to adhere with their HEP (Alasfour and Almarwani, 2020; Bennell et al., 2019; Emmerson et al., 2017).

Moreover, literature has identified different mobile apps used in enhancing HEP adherence among patients with varying success. Some of these apps including specialised apps, apps with instructional feedbacks, video and audio apps, etc. (Svingen et al., 2021; Lambert et al., 2017). Factors responsible for varying success of different mobile apps in HEP adherence have been reported to include technology-related, connectivity-related, and participant-induced considerations (Zapata et al., 2018). It has also been confirmed that mobile apps with feedbacks, alerts and reminders are more successful in helping patients adhere to HEP than those without such platforms, and more so than ordinary test messages, phone calls or handouts (Lambert et al., 2017).

Recently, WhatsApp seems to be gaining wide acceptability and applicability among several populations. Accordingly, a number of studies have examined the usefulness of WhatsApp in clinical decision-making and patient care (Kelahmetoglu et al., 2015; Astarcioglu et al., 2015; Mars et al., 2016; Bhatt and Arshad, 2016). Nardo et al. (2016) verified that WhatsApp facilitates communication, enhances learning, improves patient care and maintains privacy. Another study by Cheung et al. (2015) found that group discussion and reminders via WhatsApp was effective in preventing smoking relapse from smoking cessation while Kaliyadan et al. (2016) concluded that WhatsApp is an effective communication method among emergency surgery teams. Consequent to the foregoing it is imperative to evaluate the effectiveness of WhatsApp on adherence to HEP. Also, WhatsApp has been reported to be effective in adherence to healthy lifestyle (Tang et al., 2018), however, the use of WhatsApp in monitoring and improving HEP is yet to receive needed attention in physiotherapy. Thus, the aim of this study was to investigate the effectiveness of WhatsApp-based reminders on adherence to HEP.

2   Materials and methods

2.1   Participants

Forty patients who had smart phones with updated WhatsApp applications, and who were attending the Physiotherapy Department of the Obafemi Awolowo University Teaching Hospitals Complex (OAUTHC), Ile-Ife, Nigeria, participated in this quasi-experimental study. Excluded from the study were patients who were not competent with the use of WhatsApp. The included participants were randomised into experimental and control groups (CGs).

2.2   Procedure

Ethical approval was obtained from the Research and Ethics Committee, Institute of Public Health, Obafemi Awolowo University, Ile-Ife, Nigeria. The participants in this study were recruited conveniently. The purpose of the study was explained to the participants who met the inclusion criteria and their written informed consent was obtained. WhatsApp group was created for participants in the experimental group (EG). The experimental and CGs were given a self-designed report diary each and were instructed to mark date and time they perform and complete their HEP. Self-report dairy is the most common, simple and low cost tool used in assessing exercise adherence and has been found to be moderately correlated with accelerometer (Nicolson et al., 2017).

2.3 Intervention

The participants in the EG received WhatsApp-based reminder messages on HEP thrice weekly for six weeks. The prescribed HEP for each participant was a maximum of two so as to facilitate adherence (Eckard et al., 2015). WhatsApp reminders to carry out the HEP were sent by 8 AM every Monday, Wednesday and Friday respectively. The timing was agreed by all the participants prior to recruitment, and the green double stick/checker sign in WhatsApp was used to assess successful delivery of the HEP messages. The type of HEP messages received by each participant was tailored to the condition, severity and level of their recovery, as was considered necessary by the clinicians in charge of the patients. Participants in the CG did not receive WhatsApp-based reminder messages but were only instructed to log their HEP per day. The activity diary (days and dates) of participants in both groups were checked and recorded each week. Adherence with HEP was assessed at the third and finally at sixth week of intervention.

2.4 Data analysis

Descriptive statistics of frequency, graphs, mean and standard deviation was used to describe the data obtained from the study. Repeated measure ANOVA and independent t-test were used to determine the within-group and between-group effects of the interventions. Alpha was set at $p < 0.05$ and SPSS 23.0 version software (SPSS Inc., Chicago, IL, USA) was used for the analysis.

3 Results

The general characteristic of participants is presented in Table 1. Majority of the participants in this study were less than 15 years old (42.5%) while most of the participants were patients with orthopaedic conditions (45.0%). The results of independent t-test show that there is no significant difference between the intervention and CGs in terms of age, gender, and clinical conditions ($p > 0.05$) (Table 1).

Table 1   General characteristics of participants (N = 40)

Variables	Intervention group n (%)	Control group n (%)	X^2	p-value	All participants n (%)
Age (years)					
≤15	9 (45)	8 (40)	0.493	0.921	17 (42.5)
16–29	2 (10)	3 (15)			5 (12.5)
30–45	4 (20)	3 (15)			7 (17.5)
>45	5 (25)	6 (30)			11 (27.5)
Gender					
Male	11 (55)	10 (50)	0.100	0.752	21 (52.5)
Female	9 (45)	10 (50)			19 (47.5)
Medical condition					
Neurology	7 (35)	3 (15)	4.000	0.261	10 (25)
Orthopaedics	6 (30)	12 (60)			18 (45)
Paediatrics	6 (30)	4 (20)			10 (25)
O and G	1 (5)	1 (5)			2 (5)

Table 2 shows the result of the within-group comparison of adherence to HEP among the intervention and CG. There was significant difference in the level of adherence across baseline, third and sixth week of intervention (6.85 ± 0.37 vs. 19.95 ± 0.89 vs. 20.43 ± 0.69; F-ratio: 21,342.7; p = 0.001) and in CG (4.50 ± 0.61 vs. 13.50 ± 1.24 vs. 13.95 ± 1.61; F-ratio: 33,316.8; p = 0.001). The independent t-test shows significant difference in both intervention and CGs in adherence at the end of 3rd (13.1 ± 0.72 vs. 9.00 ± 1.26; t = 12.669; p = 0.001) and 6th week (13.6 ± 0.75 vs. 9.45 ± 1.64; t = 12.669; p = 0.001) as shown in Table 3. Furthermore, a larger percentage of the intervention group adhered with HEP consecutively for more than half (14 days) at the end of 3rd week of intervention (Figures 1 and 2).

Table 2   Repeated measure of ANOVA and post hoc comparison of effect of WhatsApp-based freminders on HEP adherence (in days) across the study period among the intervention group (n = 20), and without WhatsApp in the CG (n = 20)

Variable	Baseline	3rd week	6th week	F-ratio	p-value
	$X \pm SD$	$X \pm SD$	$X \pm SD$		
IG	6.85 ± 0.37[a]	19.95 ± 0.89[b]	20.43 ± 0.69[b]	21,342.7	0.001*
CG	4.50 ± 0.61[a]	13.50 ± 1.24[b]	13.95 ± 1.61[b]	33,316.8	0.001*

Notes: *p < 0.05; X ± SD – mean and standard deviation; IG – intervention group; CG – control group. Superscripts a, b, represent LSD post hoc analysis. For a particular variable, mode means with different superscript are significantly different (p < 0.05). Mode means with same superscripts are not significantly different (p > 0.05).

Table 3   Independent t-test comparison of HEP adherence (in days) between intervention and CG (N = 40)

Variable	Intervention	Control	t-cal	p-value
	$X \pm SD$	$X \pm SD$		
Week 3	13.1 ± 0.72	9.00 ± 1.26	12.669	0.001*
Week 6	13.6 ± 0.75	9.45 ± 1.64	12.669	0.001*

Notes: *p < 0.05; X ± SD – mean and standard deviation.

Figure 1   Effect of Whatshapp-based reminders on home program adherence at the third week of intervention (see online version for colours)
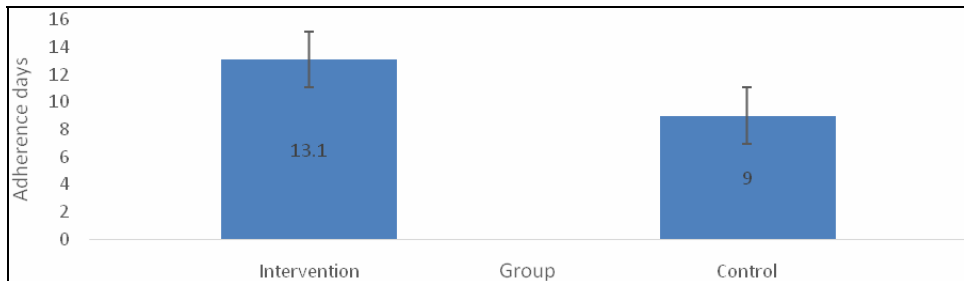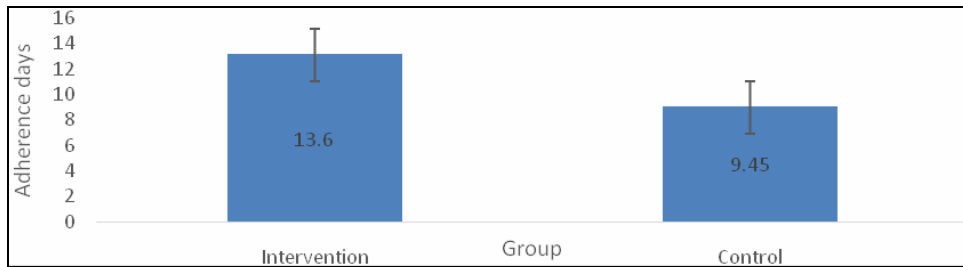
Figure 2 Effect of Whatshapp-based reminders on home program adherence at the sixth week of intervention (see online version for colours)

4 Discussion

The level of adherence to HEP in physiotherapy is reported to be unsatisfactory (Argent et al., 2018). The success of any intervention, including rehabilitation, is predicated on the level of adherence to prescribed HEP (Argent et al., 2018), and poor adherence to HEP is partly responsible for poor clinical outcomes (Svingen et al., 2021; Zapata et al., 2018; Bassett, 2003), reduces the efficiency of HCPs (Holden et al., 2014), and also has negative impact on outcome of research works (Turk and Rudy, 1991). WhatsApp has been reported to have a role to play in healthcare services, including adherence to HEP, in developing nations or low resource settings due to its peculiar characteristics (Nardo et al., 2016; Wani et al., 2013; Martyn-Hemphill et al., 2015; Astarcioglu et al., 2015; Thota and Divatia, 2015). This study investigated the effect of WhatsApp-based reminders on adherence to HEP among the outpatients receiving physiotherapy in a university teaching hospital in Nigeria.

This study found that Whatsapp-based reminders on HEP significantly improved adherence after a six week period. This finding is similar to studies conducted by Whittaker et al. (2016) and Clark et al. (2013) where adherence with a tele-health system and the use of the social media applications enhanced HEP compliance. There are various uses of mobile phone message services and smart phone-based communication applications such as Whatsapp to improve treatment adherence (Fairley et al., 2003). A number of studies have examined the usefulness of WhatsApp in clinical decision-making and patient care (Kelahmetoglu et al., 2015; Astarcioglu et al., 2015; Mars et al., 2016; Bhatt and Arshad, 2016). Nardo et al. (2016) proved the effectiveness of WhatsApp to facilitate communication, enhances learning, and improves patient care, and maintains privacy.

Bacigalupo et al. (2013) submit that the use of digital mobile technologies in healthcare is on increase, but few studies have been published exploring their effectiveness with respect to its use as a tool to improve adherence to therapy. Although WhatsApp facilitates creation of groups which allow multiple users to participate in and monitor the conversation as a social network (Abrams et al., 2015) with potential in monitoring and improving adherence to HEP, fewer studies have used WhatsApp as a means for health promotion packages aimed at increasing adherence of patients to interventions. The apparent paucity of studies in this area is a significant shortcoming for comparing the results of this study.

The significant difference between the intervention and CG as found in this study may be attributed to the effect of the WhatsApp-based reminders compared with nocebo. There was slight increase in adherence at sixth week in intervention group, but the increment was not significant, this might be due to occasional attitude of the intervention group to and ignoring social medial messages, not reading messages on time, and having a pile of messages leading to message skimming on Whatsapp. Also, some may read the messages but might get familiar with a customised or stereotype message and thus not perform the home program. However, the result of this study showed that WhatsApp-based messages through smartphone may be an effective platform to enhance adherence to HEP.

This study has few potential limitations that can limit the generalisability of the findings. We could not analyse some confounding factors like motivation, disease severity, access to caregiver, marital status, occupation or psychological health which can tilt results of adherence to HEP as found in this study. Also, though participants were encouraged at weekly meeting to complete their HEP and to log their adherence in a provided diary, we could not ascertain whether the participants actually carried out the exercise fully and as prescribed. It has been reported that there is difference between logged adherence and true adherence (Nicolson et al., 2017). Another potential limitation of this study may be possible cross-over effect resulting from patient to patient interaction which was difficult to control. Despite these, this study provides evidence that WhatsApp-based intervention, a common mobile app which is cheap and easy to use, is viable in improving HEP adherence, and should be considered as a means of improving adherence to HEP in physiotherapy. Future studies with larger sample size are needed to investigate the long-term adherence to HEP using WhatsApp-based reminders. Furthermore, studies utilising WhatsApp that includes features which are capable of objectively monitor adherence other than self-reporting, and that can provide remote feedback are warranted.

5   Conclusions

WhatsApp-based reminders significantly improve adherence to HEP among patients receiving physiotherapy.

References

Abrams, K.M., Wang, Z. and Song, Y.J. (2015) 'Data richness trade-offs between face-to-face, online audiovisual, and online text-only focus groups', *Social Science Computer Review*, Vol. 33, No. 1, pp.80–96.

Alasfour, M. and Almarwani, M. (2020) 'The effect of innovative smartphone application on adherence to a home-based exercise programs for female older adults with knee osteoarthritis in Saudi Arabia: a randomized controlled trial', *Disabil and Rehabil.*, October, pp.1–8.

Argent, R., Daly, A. and Caulfield, B. (2018) 'Patient involvement with home-based exercise programs: can connected health interventions influence adherence?', *JMIR Mhealth Uhealth*, Vol. 6, No. 3, p.e47.

Astarcioglu, M.A., Sen, T., Kilit, C., Durmus, H.I., Gozubuyuk, G., Kalcik, M., Karakoyun, S., Yesin, M., Augus, H.Z. and Amasyali, B. (2015) 'Time-to-reperfusion in STEMI undergoing interhospital transfer using smartphone and WhatsApp messenger', *Am. J. Eerg. Med.*, Vol. 33, No. 10, pp.1382–1384.

Aungst, T.D. (2013) 'Medical applications for pharmacists using mobile devices', *Ann. Pharmacother.*, Vol. 47, Nos. 7–8, pp.1088–1095.

Bacigalupo, R., Cudd, P., Littlewood, C., Bissell, P., Hawley, M.S. and Woods, H.B. (2013) 'Interventions employing mobile technology for overweight and obesity: an early systematic review of randomized controlled trials', *Obes. Rev.*, Vol. 14, No. 4, pp.279–291.

Bassett, S.F. (2003) 'Measuring patient adherence to physiotherapy', *N.Z.J. Physiother.*, Vol. 31, No. 2, pp.60–61.

Beinart, N.A., Goodchild, C.E., Weinman, J.A., Ayis, S. and Godfrey, E.L. (2013) 'Individual and intervention-related factors associated with adherence to home exercise in chronic low back pain: a systematic review', *Spine J.*, Vol. 13, No. 12, pp.1940–1950.

Bennell, K.L., Marshall, C.J. and Dobson, F. (2019) 'Does a web-based exercise programming system improve home exercise adherence for people with musculoskeletal conditions? A randomized controlled trial', *Am. J. Phys. Med. Rehabil.*, Vol. 98, No. 10, pp.850–858.

Bhatt, A. and Arshad, M. (2016) 'Impact of WhatsApp on youth: a sociological study', *IRA International Journal of Management and Social Sciences*, Vol. 4, No. 2, pp.376–386.

Bollen, J.C., Dean, S.G., Siegert, R.J., Howe, T.E. and Goodwin, V.A. (2014) 'A systematic review of measure of self-reported adherence to unsupervised home-based rehabilitation exercise programmes, and their psychometric properties', *BMJ Open*, Vol. 4, No. 6, p.e005044.

Campbell, R., Evans, M., Tucker, M., Quilty, B., Dieppe, P. and Donovan, J. (2001) 'Why don't patients do their exercises? Understanding non-compliance with physiotherapy in patients with osteoarthritis of the knee', *J. Epidemiol. Community Health*, Vol. 55, No. 2, pp.132–138.

Cheung, Y.T., Chan, C.H., Lai, C.K., Chan, W.F., Wang, M.P., Li, H.C., Chan, S.S. and Lam, T.H. (2015) 'Using WhatsApp and Facebook online social groups for smoking relapse prevention for recent quitters: a pilot pragmatic cluster randomized controlled trial', *J. Med. Internet Res.*, Vol. 17, No. 10, p.e238.

Clark, A.M., King-Shier, K.M. and Spaling, M.A. (2013) 'Factors influencing participation in cardiac rehabilitation programmes after referral and initial attendance: qualitative systematic review and meta-synthesis', *Clin. Rehabil.*, Vol. 27, No. 10, pp.948–959.

Divali, P., Camosso-Stefinovic, J. and Baker, R. (2013) 'Use of personal digital assistants in clinical decision making by health care professionals: a systematic review', *Health Informatics J.*, Vol. 19, No. 1, pp.16–28.

Eckard, T., Lopez, J., Kaus, A. and Aden, J. (2015) 'Home exercise program compliance of service members in the deployed environment: an observational cohort study', *Mil. Med.*, Vol. 180, No. 2, pp.186–191.

Emmerson, K.B., Harding, K.E. and Taylor, N.F. (2017) 'Home exercise programmes supported by video and automated reminders compared with standard paper-based home exercise programmes in patients with stroke: a randomized controlled trial', *Clin. Rehabil.*, Vol. 31, No. 8, pp.1068–1077.

Fairley, C.K., Levy, R., Rayner, C.R., Allardice, K., Costello, K. and Thomas, C. (2003) 'Melbourne Adherence Group. Randomized trial of an adherence programme for clients with HIV', *Int. J. STD AIDS*, Vol. 14, No. 12, pp.805–809.

Hayden, J.A., van Tulder, M.W. and Tomlinson, G. (2005) 'Systematic review: strategies for using exercise therapy to improve outcomes in chronic low back pain', *Ann. Intern. Med.*, Vol. 142, No. 9, pp.776–785.

Holden, M.A., Haywood, K.L., Potia, T.A., Gee, M. and McLean, S. (2014) 'Recommendations for exercise adherence measures in musculoskeletal settings: a systematic review and consensus meeting (protocol)', *Syst. Rev.*, Vol. 3, No. 3, p.10.

Horne, R. (2006) 'Compliance, adherence, and concordance: implications for asthma treatment', *Chest.*, Vol. 130, No. 1, pp.65S–72S.

Jolly, K., Taylor, R.S., Lip, G.Y.H. and Stevens, A. (2016) 'Home-based cardiac rehabilitation compared with centre-based rehabilitation and usual care: a systematic review and meta-analysis', *Int. J. Cardiol.*, Vol. 111, No. 3, pp.343–351.

Kaliyadan, F., Ashique, K.T., Jagadeesan, S. and Krishna, B. (2016) 'What's up dermatology? A pilot survey of the use of WhatsApp in dermatology practice and case discussion among members of WhatsApp dermatology groups', *Indian J. Dermatol. Venereol. Leprol.*, Vol. 82, No. 1, pp.67–69.

Kelahmetoglu, O., Firinciogullari, R. and Yagmur, C. (2015) 'Efficient utility of WhatsApp: from computer screen to the surgeon's hand to determine maxillofacial traumas', *J. Craniofac. Surg.*, Vol. 26, No. 4, p.1437.

Lambert, T.E., Harvey, L.A., Avdalis, C., Chen, L.W., Jeyalingam, S., Pratt, C.A., Tatum, H.J., Bowden, J.L. and Lucas, B.R. (2017) 'An app with remote support achieves better adherence to home exercise programs than paper handouts in people with musculoskeletal conditions: a randomised trial', *J. Physiother.*, Vol. 63, No. 3, pp.161–167.

Mars, M., Scott, R. and Jordanova, M. (2016) 'Whats (h) app (ening) in telemedicine?', *J. Int. Soc. Telemede Health*, Vol. 4, No. e1, pp.1–2.

Martyn-Hemphill, C., Sarkar, S., Withington, J., Roy, A., Chisholm, R., Newton, T., Ottaviani, D., Pidgeon, C., Szamocki, S. and Cohen, D. (2015) 'MP16-06 – 'WhatsApp Doc?' Evaluating a novel modality of communication amongst urology team members to promote patient safety', *J. Urol.*, Vol. 193, No. 4, pp.e169–e170.

Nardo, B., Cannistrà, M., Diaco, V., Naso, A., Novello, M., Zullo, A., Ruggiero, M., Grande, R. and Sacco, R. (2016) 'Optimizing patient surgical management using WhatsApp application in the Italian healthcare system', *Telemed. J. E-Health*, Vol. 22, No. 9, pp.718–725.

Nicolson, B.P.J.A., Hinman, R.S., Wrigley, T.V., Stratford, P.W., Lilje, K.L.S.C., Olander, E., Berglund, J., Skillgate, E. and Anderberg, P. (2017) 'Experience of older adults with mobile phone text messaging as reminders of home exercise after specialized manual therapy for recurrent low back pain: a qualitative study', *JMIR Mhealth Uhealth*, Vol. 30/5, No. 3, p.e39.

Svingen, J., Rosengren, J., Turesson, C. and Arner, M. (2021) 'A smartphone application to facilitate adherence to home-based exercise after flexor tendon repair: a randomised controlled trial', *Clin Rehabil.*, Vol. 35, No. 2, pp.266–275.

Tang, Y.H., Chong, M.C., Chua, Y.P., Chui, P.L., Tang, L.Y. and Rahmat, N. (2018) 'The effect of mobile messaging apps on cardiac patient knowledge of coronary artery disease risk factors and adherence to a healthy lifestyle', *J. Clin. Nurs.*, Vol. 27, Nos. 23–24, pp.4311–4320.

Thota, R.S. and Divatia, J.V. (2015) 'WhatsApp: what an app!', *India J. Crit. Care Med.*, Vol. 19, No. 6, pp.363–365.

Turk, D.C. and Rudy, T.E. (1991) 'Neglected topics in the treatment of chronic pain patients-relapse, noncompliance, and adherence enhancement', *Pain*, Vol. 44, No. 1, pp.5–28.

Wallace, S., Clark, M. and White, J. (2012) ''It's on my iPhone': attitudes to the use of mobile computing devices in medical education, a mixed-methods study', *BMJ Open*, Vol. 2, No. 4, p.e001099.

Wani, S.A., Rabah, S.M., Alfadi, S., Dewanjee, N. and Najmi, Y. (2013) 'Efficacy of communication amongst staff members at plastic and reconstructive surgery section using smartphone and mobile WhatsApp', *India J. Plast. Surg.*, Vol. 46, No. 3, pp.502–505.

Whittaker, R., Borland, R., Bullen, C., Lin, R.B., McRobbie, H. and Rodgers, A. (2016) 'Mobile phone-based interventions for smoking cessation', *Cochrane Database Syst. Rev.*, Vol. 4, No. 4, p.CD006611

Zapata, K.A., Wang-Price, S.S., Fletcher, T.S. and Johnston, C.E. (2018) 'Factors influencing adherence to an app-based exercise program in adolescents with painful hyperkyphosis', *Scoliosis and Spinal Disord.*, Vol. 13, No. 1, p.11.