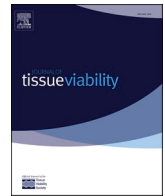




Contents lists available at ScienceDirect

Journal of Tissue Viability

journal homepage: www.elsevier.com/locate/jtv

A pilot study for testing feasibility and preliminary influence of early intervention using text messaging for pressure ulcer prevention in individuals with spinal cord injury

Liang Q. Liu^{a,*}, Rachel Deegan^b, Hester Dunne^c, Sarah L. Knight^b, Helen T. Allan^a, Angela Gall^{b,1}

^a Centre for Critical Research in Nursing & Midwifery, Department of Nursing and Midwifery, Faculty of Health, Social Care and Education, Middlesex University, London, UK

^b London Spinal Cord Injury Centre, Royal National Orthopaedic Hospital, UK

^c National Spinal Injuries Centre, Stoke Mandeville Hospital, UK

ARTICLE INFO

Keywords:

Spinal cord injury
Pressure ulcer prevention
Text message
Attitude
Pilot
Interventional study

ABSTRACT

Background: This pilot study assessed text messaging as an early intervention for preventing pressure ulcers (PrUs) in individuals with spinal cord injury (SCI) post-hospital discharge.

Method: Thirty-nine wheelchair-users discharged after acquiring a SCI, underwent randomisation into an intervention group (n = 20) with text messages and a control group (n = 19). All participants received standard post-discharge care and completed a skincare questionnaire before and 6-month after discharge. Primary outcomes included feasibility and acceptability of early intervention using text messaging, alongside performance, concordance, and attitudes toward skincare. Secondary outcomes measured perception and the incidence of PrUs.

Results: Baseline demographics were comparable between the intervention and control groups. Eight of 20 participants completed 6-month follow-up questionnaires in the intervention group, six participants completed the 6-month questionnaires in the control group. Participants expressed high satisfaction with text messages, understanding of content, and increased confidence in preventing PrUs. At 6-month post-discharge, the intervention group showed improved prevention practices, heightened awareness of PrU risks, and increased perceived importance of prevention, which were not observed in the control group. However, there were no significant differences in PrU incidence, possibly due to the small sample size and short follow-up.

Conclusion: The study demonstrates that using text messaging as an early intervention for PrU prevention in individuals with SCI is feasible and well-received. Preliminary results suggest a positive impact on participants' attitudes and practices, indicating the potential of text messaging to reduce PrU incidence. However, further research with larger samples and extended follow-up is crucial to validate these promising initial findings.

1. Background

Approximately 105,000 people living with a Spinal Cord Injury (SCI) in the UK [1,2]. Pressure ulcers (PrUs) are the most common devastating complication associated with SCI [3,4]. After a SCI, PrUs can occur at early stage, often within days. A multicentre study reported a 36.5 % occurrence during acute rehabilitation 39.4 % during functional rehabilitation, and most of them are located at the sacrum (43 %), heel (19

%), and ischium (15 %) [5]. The annual PrU incidence is reported at 14.7 % in the first year post-injury, steadily increasing thereafter [6], with up to 85 % developing a PrU during their lifetime, resulting in 7–8% mortality from related complications [3,6–8].

According to the National/European Pressure Ulcer Advisory Panel (NPIAP/EPUAP) guideline, a PrU is a localised skin injury from prolonged pressure alone or combined with shearing forces, categorised into four stages based on severity ranging from stage 1 (skin

* Corresponding author. Department of Nursing and Midwifery, Faculty of Health, Social care and Education, Middlesex University, The Burroughs, Hendon, London, NW4 4BT, UK.

E-mail address: L.Q.Liu@mdx.ac.uk (L.Q. Liu).

¹ Department of Rehabilitation Medicine, Woodend Hospital, Aberdeen, UK.

<https://doi.org/10.1016/j.jtv.2024.06.013>

Received 23 January 2024; Received in revised form 4 June 2024; Accepted 27 June 2024

Available online 28 June 2024

0965-206X/© 2024 Published by Elsevier Ltd on behalf of Tissue Viability Society / Society of Tissue Viability.

discoloration) to stage 4 (muscle and bone involvement) [9]. After a SCI, the disruption of spinal vasomotor pathways leads to a loss of vasomotor control over muscles and skin, reducing vascular bed tone below the lesion level. This impairs vascular patency, making vessels less resistant to normal loading conditions. Combined with the loss of capillary networks and muscle bulk, tissue blood volume decreases [10–12]. Consequently, individuals with SCI expose a higher risk of PrU development than able-bodied individuals. It is estimated that about a third to half of PrU incidence results from sitting in a wheelchair in this population [13,14].

Once a PrU develops, achieving full repair becomes extremely challenging, leading to prolonged hospital stays, delayed rehabilitation, and significant loss of independence [15]. Severe PrUs may result in additional disabilities, surgical interventions, and fatal infections [15, 16]. Besides personal consequences, PrUs represent a substantial financial burden, with treatment costs ranging from £1214 to £14,108 per case in the UK [16,17]. PrUs contribute to approximately 25 % of overall treatment costs for SCI individuals [18,19]. Given these consequences and the healthcare burden, effective PrU prevention is vitally important [19].

Despite tremendous efforts made by SCI professionals, including research on developing pressure-relieving cushions and assessment tools, and patient-performed pressure-relieving maneuvers [13,17,18, 20,21], PrU incidence remains unacceptably high [22]. Following a SCI, PrU education is typically provided during the early rehabilitation stage in the hospital, while patients still adapting to their injury. They are advised on adopting a healthy lifestyle, inspecting skin, and performing pressure relief. However, during rehabilitation, patients' psychological states may hinder full comprehension of PrU preventive measures. After discharge, adherence to skincare regimens varies based on patients' environments and activities. Poor concordance to skincare regimens, as noted in previous studies, increases the risk of PrU development [22,23]. Promoting concordance in skincare management is crucial to prevent PrUs, ultimately reducing the financial burden on individuals and healthcare services.

Previous studies show that behavioral interventions, like text messaging reminders, enhance adherence to medical treatments such as antiviral therapy, obesity, and diabetes self-management. WHO guidelines also recommend text messaging to promote adherence to antiretroviral therapy. Thus far, no study has explored early intervention with educational text messages for PrU prevention in SCI. Therefore, we conducted a pilot study to assess the feasibility and initial impact of early intervention using educational text messages on skincare regimens for PrU prevention in SCI.

Aim of the Study: 1) To evaluate the feasibility and satisfaction of using text messaging as a reminder for PrU prevention among people with SCI; 2) To preliminarily examine whether using text messaging as an early intervention can change their concordance to the PrU prevention regimen, and their perception of PrU among people who were discharged from the hospital following a newly SCI.

2. Method

The study was approved by the Health and Social care ethics sub-committee (ref.1195), Middlesex University, London, United Kingdom, and National Research Ethics Committee/Health Research Authority (IRAS ID 219199, REC ref. 17/SW/0097). The study was registered to ISRCTN 38320572, and NIHR Clinical Research Network Portfolio (ID 34112). All participants were provided with a participant information sheet and gave voluntary consent prior to data collection.

2.1. Participants

The original calculation of this pilot study expected a minimum of 12 and maximum of 20 in each group. Patients who were in rehabilitation ward at the Spinal Cord Injury unit of the Royal National Orthopaedic

Hospital (RNOH) and the National Spinal Cord Injury Centre of Stoke Mandeville Hospital were invited to participate. Patients with SCI at all level of suprasacral complete or incomplete, age 18 or older, who read English were eligible to participate. Exclusion criteria were patients who did not understand English, and medically unstable SCI patients.

2.2. Study design

We conducted a pilot two-group interventional study. Text message interventions were randomly allocated to each participant. In order to produce equal number of participants in study arms for a small sample sized study, a block randomisation process was used to assign subjects to either the intervention or without any early intervention [27]. The randomized list was generated in Excel before any patients were screened and consented to take part in the study. The chief investigator (LQL) kept the list in a password locked computer and only informed the staff who recruited the patients at hospital with the allocation once a patient was recruited and signed the consent form.

2.3. Intervention

All participants gave informed consent before they were allocated to one of the two groups. Group I received a text message reminder two times a week for six months after they were discharged from the hospital; Group II received no text messages. All patients received standard outpatient's follow-up care.

The text messages were created to provide educational reminders and encouragement for PrU prevention, covering skincare, pressure relief and healthy habits. The content was based on comprehensive literature reviews, guidelines from NPIAP/EPUAP, local SCI rehabilitation educational resources, and consultations with SCI tissue viability experts to ensure accuracy and relevance, aiming to improve concordance to PrU prevention practices.

Participants in the intervention group received a welcome message introducing the study and its purpose the week before receiving text message reminders. In the first four weeks, the educational messages focused on different themes each week: the importance of a skincare routine and pressure relief in Week 1, checking the skin for early signs of pressure sores in Week 2, awareness of skin changes along with hydration and nutrition in Week 3, and the use of proper clothing and equipment to prevent skin sores in Week 4. From Week 5 onward, follow-up messages provided ongoing reminders about maintaining good posture, regular repositioning, and performing skin checks. The detailed content of text message shown in [Appendix I](#).

Data were collected at baseline (immediately after the consent or shortly before discharged from the hospital) and 6 months after being discharged.

2.4. Primary outcome

- 1) Acceptability and satisfactory of using text messaging as an early intervention for pressure ulcer prevention. All patients who received text messaging were asked to complete an 8-question questionnaire after 6 months of the study.
- 2) Practice, concordance and attitude towards skin inspection and 'pressure-relieving' regimen. We asked patients to complete a skincare questionnaire [28]. The questions related to performing a skincare management regimen included the frequency of performing skin inspection and pressure-relieving exercises. Details of the items alongside scores for concordance and attitude questions are reported previously [28]. Concordance score was calculated as average scores of 6 items (range 1–5). Higher scores indicate higher levels of concordance; Score of perceived benefit of performing 'pressure-relieving' was calculated as average scores of 7 items (range 1–5). Higher scores indicate a higher level of belief in benefit to performing pressure-relieving exercises; score of perceived negative

consequences of pressure-relieving exercises (concern) was calculated as average scores of six items (range 1–5). A higher score indicates a higher level of perceived unfavourableness of pressure-relieving exercises; the score of practical barrier factor was calculated as average scores of 7 items (range 1–5). A higher score indicates more practical barriers to performing pressure-relieving.

2.5. Secondary outcome

- 1) Perceptions of PrU. We asked participants to complete the eight-items of the modified Brief Illness Perception Questionnaire (mBIPQ) [29] to measure perceptions of PrU. The mBIPQ score was calculated as sum of all eight items to give a score ranging from 0 to 80. A higher score indicates a greater level of concern, viewing the PrU as more threatening.
- 2) Number of skin problem (incidence of pressure ulcer I-IV) were recorded at baseline, and six months after discharge.

2.6. Data analysis

To analyse the data, we calculated descriptive and inferential statistics using the Excel 2010 and SPSS version 25 for Windows (IBM SPSS statistics 25). All raw data tested for normality distribution using the Shapiro-Wilk test. For the comparison of continuous data between pre-(baseline) and post-intervention (six months), paired student's t-test was

used for normal distributed data, or Wilcoxon test for non-normal distributed data. For the comparison of continuous data between two intervention groups, independent t-test was used for normal distributed data, or Mann-Whitney test for non-normal distributed data. The differences are considered to be statistically significant for P value less than 0.05 (two tailed).

3. Results

3.1. Participants attritions and characteristics

A total of 39 participants were enrolled and provided informed consent. Twenty of them were randomly allocated to intervention group, 19 participants were assigned to 'control group', in which they received standard post-discharge care without receiving text messages. Thirty-eight of them completed baseline questionnaire fully. One participant completed less than half questions and another one died during the follow up study period. Both of them were from the control group and were excluded from the analysis. Within 37 participants, fourteen participants returned their questionnaire within six months after discharge from hospital, eight of them were in the 'intervention group', six were in 'control group'. Fig. 1 shows a flowchart of participants attritions.

The majority of participants were male (27/37), one-third of them have had a history of developing PrU. The level of incomplete or completed injury range from the second cervical (C2) to the first lumbar (L1). Table 1 shows basic characteristics of 37 participants.

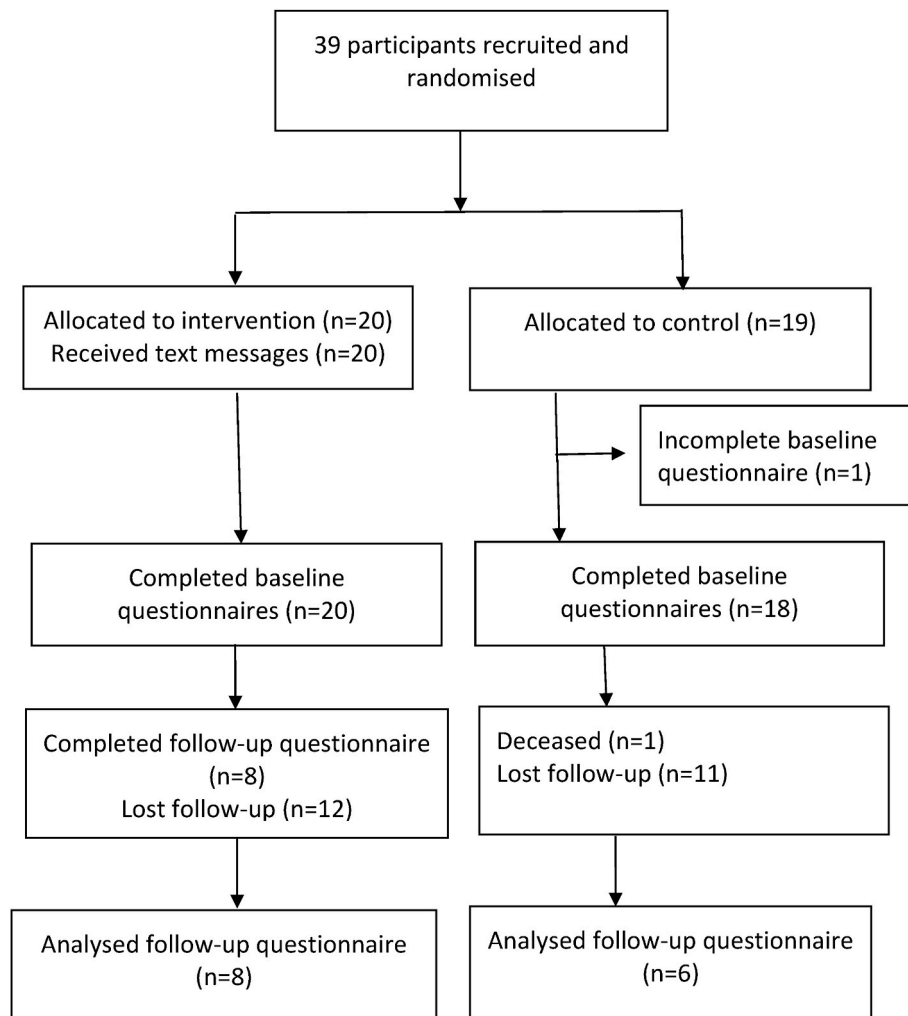


Fig. 1. A flowchart of participants enrollment.

Table 1
shows the demographics of the participants.

Characteristic	Intervention group	Control group	Overall
Gender n (%)			
Male	18(90)	9(52.9)	27 (73)
Female	2(10)	8(47.1)	10 (27)
Age years (SD)	49.7 (15.8)	54.3(18)	51.8 (16.8)
Duration of injury (months)	7.83 (3.7)	7.62 (3.6)	232(106)
Ethnicity n (%)			
White	14(70)	11(64.7)	25 (67.6)
Asian/Asian British	2(10)	2(11.8)	4 (10.8)
Black/Black British	2(10)	2(11.8)	4 (10.8)
Mixed	2(10)	0	1 (2.7)
Other	2(10)	2(11.8)	3 (8.1)
Marital status n(%)			
Single/never married	7(35)	8 (47.1)	15 (40.5)
Married/living with a partner	10(50)	7 (41.2)	17 (45.9)
Widowed, divorced separated	3 (15)	2(11.8)	5 (13.5)
Smoking status n (%)			
Never	10(50)	8(47.1)	18 (48.6)
Used to	9(45)	5(29.4)	14(37.8)
Yes	0(0)	4(23.5)	4(10.8)
missing	1(5)	0(0)	1(2.8)
Pressure ulcer history n (%)			
Yes	7 (35)	4(23.5)	11(30.6)
No	12 (60)	12(70.6)	24(66.7)
missing	1(5)	1(5.9)	1(2.7)

3.2. Outcomes

3.2.1. Attitude, concordance to pressure prevention regimen scores

As a whole group of those 37 participants who completed the attitude and concordance to skin care questionnaire before they were discharged, individuals viewing PrU as a threatening illness were significantly associated with lower scores of perceived negative consequences (concern) about performing pressure-relieving ($r = 0.42$; $p = 0.01$), and lower score of practical barriers performing pressure-relieving. ($r = -0.43$; $p = 0.009$). Individuals viewing pressure relieving as conferring more perceived benefit reported lower score of concern ($r = -0.33$; $p < 0.05$), practical barriers ($r = -0.41$; $p = 0.01$).

3.2.2. Effect of text messaging on performance and concordance of 'pressure relief'

In terms of impact of text messaging as a reminder/intervention, at six months post discharge, participants receiving text messaging reported performing more pressure relief exercises (71.7 % at baseline vs. 86.7 % at 6 months, $p = 0.02$) and more days of inspecting their skin during the week (4.75 days at baseline vs 6.75 days at six months, $p = 0.04$); participants in the intervention group also became less concerned about negative impact of doing pressure relieving over time (2.72 at baseline vs 2.60 at six months, $p = 0.04$), and reported fewer barriers to perform pressure relieving (2.73 at baseline vs 2.55 at six months, $p = 0.01$). Additionally, participants received text messaging viewed PrU as a more threaten illness (67.1 % at baseline vs. 69.6 % at six months, $p = 0.05$). The baseline and follow-up results for both intervention and control groups can be found in Table 2.

3.2.3. Satisfaction from of text messages

Of the 14 participants who completed follow up questionnaires, eight of them were in the intervention group, four of them responded to eight satisfaction questions regarding text messaging. In response to the satisfaction questions, 'The information in the text message is easy to understand' and 'The text messages include all the information I need', all participants responded 'agree', one of them indicated 'strongly agree' for both statements. In response to the question, "Receiving text message

Table 2
shows baseline (pre-) and follow up (post-) performing skin care practice, attitude and concordance scores of skin care and perception of PrU.

Variables	Intervention			Control		
	Baseline Mean (SD)	6-month Mean (SD)	P value	Baseline Mean (SD)	6-month Mean (SD)	P value
Days of skin inspection	4.75 (2.76)	6.75 (0.71)	0.04*	4.20 (3.83)	6.40 (0.89)	0.27
% of pressure relieving	71.7 (19.4)	86.7 (12.1)	0.02*	60.7 (32.2)	66.8 (27.3)	0.42
Concordance	4.1 (0.59)	4.15 (0.39)	0.24	4.13 (0.48)	3.83 (0.94)	0.39
Perceived benefit	4.10 (0.42)	4.32 (0.36)	0.37	4.51 (0.42)	4.24 (0.19)	0.18
Perceived concern	2.72 (0.54)	2.60 (0.49)	0.04*	2.47 (0.78)	2.45 (0.85)	0.1
Practical barriers	2.73 (0.68)	2.55 (0.59)	0.01*	2.95 (0.68)	2.67 (0.61)	0.09
BIPQ	67.07 (6.35)	69.6 (5.03)	0.05*	66.78 (5.0)	61.71 (7.88)	0.37

improved my confidence for preventing a pressure ulcer, all responded 'agree', other than one who indicated 'strongly agree'. In response to other five questions, "The content of the text message is helpful", "The precision of wording in the text message is good", "Receiving text message twice a week is ideal", "Receiving text message for six months is ideal", "I would recommend sending the text messaging to my peers". All four participants indicated 'agree'. Table 3 shows response of those participants completed the satisfaction questionnaires.

4. Discussion

The lack of awareness of skin care after patients with SCI are discharged from hospital together with lack of knowledge or loss of motivation to adhere to pressure relief regimen has been identified from previous studies [22,23]. Our pilot study successfully tested a text messaging intervention to promote PrU prevention for people who were discharged from the hospital after a new SCI. We present the findings of this pilot interventional study with a control group, aimed at evaluating the feasibility and acceptability of utilising text messaging as an early intervention for delivering skincare education. Additionally, we explore its potential influence in PrU prevention. Overall, the text messaging was well-received by participants. Those participants who received text messages agreed that the information in the text messages was easy to understand and included all the necessary information. This high satisfaction extended to various aspects, such as the helpfulness of the content, precision of wording, ideal frequency of message receipt, and

Table 3
shows response of those participants completed the satisfaction questionnaires.

Satisfaction questions	Strongly agree	Agree
The information in the text message is easy to understand	1(25 %)	3(75 %)
The text messages include all the information I need	1(25 %)	3(75 %)
Receiving text message improved my confidence for preventing a pressure ulcer	1(25 %)	3(75 %)
The content of the text message is helpful	0(0 %)	4(100 %)
The precision of wording in the text message is good	0(0 %)	4(100 %)
Receiving text message twice a week is ideal	0(0 %)	4(100 %)
Receiving text message for six months is ideal	0(0 %)	4(100 %)
I would recommend sending the text messaging to my peers	0(0 %)	4(100 %)

the recommendation of the messaging to peers. In terms of preliminary effectiveness of text messaging as an early intervention, participants who received text messaging reported a significant increase in the performance of pressure relief exercises, indicating the positive impact of text messaging as a reminder/intervention. The frequency of skin inspection also improved among participants receiving text messages, emphasising the role of text messaging in promoting consistent skin care practices. Participants in the text messaging group reported a decrease in concern and perceived barriers related to pressure relief at six months post discharge. This suggests that the intervention positively influenced participants' attitudes and perceived obstacles associated with pressure-relieving activities.

In terms of PrU incidence, people living with a SCI have a permanent risk of developing PrU during their life time with approximately 20–30 % of individuals developing PrUs within 1–5 years after the injury [5–7]. In this pilot study, there appears to be a trend towards a lower proportion of PrU incidence within six months after discharge in the 'text messaging' group than those in the 'control' group. This difference did not reach significance between people receiving text messaging and those without receiving text messages. We cannot draw conclusions from this insignificant result due to the nature of the pilot design, which involves a small sample size and a short follow-up period.

Our findings are in line with previous studies reporting text messaging-related behaviour changes, such as improving adherence to home exercise, diabetes self-management, cardiovascular medication alongside many other medical treatments, ultimately improve patients outcomes [24–26]. Although a variety of modes of delivering education in PrU prevention in the community have been reported in the literature, including face-to-face training, E-learning programs, telehealth intervention programs, telephone follow-up, and behaviour contingencies [30–32], these interventions employ various approaches and incur varying financial expenses. For instance, face-to-face training requires a number of medical personnel or a large number of SCI patients to involve. Intensive E-learning programs need patients to be self-motivated in participating in the online e-learning, which is not always feasible or durable. To facilitate effective interventions that minimise the personal and financial burden of implementation, text messaging offers researchers and healthcare professionals the flexibility to customise message content, promoting compliance through reminders. Over the last two decades, global ownership of mobile cellular phones has experienced significant growth. There are nearly as many mobile phone subscriptions as there are people worldwide. Using text messaging as a reminder to prompt patients' awareness and adherence to PrU prevention regimens has the potential to alter individuals' behaviour, encouraging regular skin inspection and pressure relief and ultimately preventing the development of PrUs.

5. Limitations

While our study offers preliminary valuable insights, there are limitations that require consideration. This pilot study tested a relatively small sample over a short follow-up period. Although significant changes were observed in some parameters before and after 6-month post-discharge among participants receiving text messages, firm conclusions cannot be drawn regarding whether any significant difference between intervention and control group. Nevertheless, trends were observed in all parameter scores in the right direction.

Secondly, this study recorded a low rate (38 %) of return of follow-up questionnaires, at 6-month post-discharge, which highlight a common dropout challenge in clinical trials ranging from 0 % to 75 % in the literature [33]. Collecting follow-up data via postal questionnaires poses a significant challenge, contributing to the low questionnaire return rates. Future studies should explore flexible approaches, such as QR codes for online completion or phone interviews for hard-to-reach participants, to enhance data collection and engagement. Effective communication throughout a clinical trial is crucial for recruitment,

enrollment, and retention, involving understanding patients' day-to-day experiences, personalized interactions, and tailored messaging to increase retention likelihood [34].

Thirdly, the pilot study utilised a validated instrument to assess aspects of PrU prevention practices, but it didn't cover all education program content, including nutrition and caregiver issues. Larger trials are needed to confirm outcomes and effects on specific preventive behaviors. Further studies should empirically examine if concordance with behaviors like pressure relief, skin checks, and engagement in exercise and healthy nutrition results in fewer PrUs. Additionally, long-term follow-up with text message recipients is crucial to assess if skincare practices and behaviors towards PrU prevention are sustained.

6. Implications and recommendations

The study highlights a lack of skincare awareness and motivation among individuals with SCI post-hospital discharge. The successful text messaging intervention addresses this gap, demonstrating practicality, feasibility, and acceptability. Participants showed increased pressure relief exercises, improved skin inspection frequency, and reduced concerns and perceived barriers to pressure-relieving 6-month post-discharge. These changes are vital for preventing PrUs and ensuring consistent skincare practices. Integrating text messaging into routine care offers a cost-effective approach to promoting adherence in the SCI population.

To validate effectiveness, future research should explore larger and longer interventions, understanding sustained effects on skincare practices and PrU prevention. Enhancing participant engagement, customizing content, and addressing follow-up challenges are crucial for robust data collection. Considering global mobile phone ownership, public health initiatives could incorporate text messaging as a scalable tool to promote awareness and adherence to PrU prevention among individuals with SCI.

7. Conclusion

We developed an early post-discharge educational text messaging intervention aimed at reminding people with a SCI about PrU prevention. A pilot study with 37 participants showed positive effects on performance, concordance, and perception. However, due to the small sample size, conclusions about its impact on PrU incidence cannot be drawn. Larger and longer studies are needed for validation. Participants expressed high satisfaction, indicating the potential effectiveness of text messaging in preventing PrUs in those with SCI. This study sets the stage for further research on early interventions like text messaging for enhancing PrU prevention in SCI individuals.

Funding

This work was funded by a research grant from the Rosetree Trust (A1324), United Kingdom.

Declaration of competing interest

No conflicts of interest.

Acknowledgment

Authors would like to give special thanks to Ms. Iwona Pacosz and Mr. James Cooper for setting up the text messaging system, Ufedo Miachi for guiding and supporting us through the National Health Research Authority ethics approval. We also appreciate Ms. Nilam Mehta for helping with data entry and data processing. Lastly, sincere thanks to all participants, especially those who completed follow-up questionnaires. The study wouldn't have been possible without all their generous assistance.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jtv.2024.06.013>.

References

- [1] <https://www.aspire.org.uk/> Accessed on 30 May 2024.
- [2] <https://spinal-research.org/> Accessed on 30 May 2024.
- [3] Makhosou M, Lin F, Knaus E, et al. Promote pressure ulcer healing in individuals with spinal cord injury using an individualized cyclic pressure-relief protocol. *Adv Skin Wound Care* 2009;22(11):514–21. <https://doi.org/10.1097/01.ASW.0000305495.77649.ee>.
- [4] Shiferaw WS, Akalu TY, Mulugeta H, et al. The global burden of pressure ulcers among patients with spinal cord injury: a systematic review and meta-analysis. *BMC Musculoskel Disord* 2020;21:334. <https://doi.org/10.1186/s12891-020-0336>.
- [5] Verschueren JH, Post MW, de Groot S, van der Woude LH, van Asbeck FW, Rol M. Occurrence and predictors of pressure ulcers during primary in-patient spinal cord injury rehabilitation. *Spinal Cord* 2011;49(1):106–12. <https://doi.org/10.1038/sc.2010.66>.
- [6] Garber SL, Rintala DH, Hart KA, Fuhrer MJ. Pressure ulcer risk in spinal cord injury: predictors of ulcer status over 3 years. *Arch Phys Med Rehabil* 2000;81:465–71. <https://doi.org/10.1053/mr.2000.3889>.
- [7] Ash D. An exploration of the occurrence of PUs in a British spinal injuries unit. *J Clin Nurs* 2002;11(4):470–8. <https://doi.org/10.1046/j.1365-2702.2002.00603.x>.
- [8] Cardenas DD, Hoffman JM, Kirshblum S, McKinley W. Etiology and incidence of rehospitalization after traumatic spinal cord injury: a multicenter analysis. *Arch Phys Med Rehabil* 2004;85:1757–63. <https://doi.org/10.1016/j.apmr.2004.03.016>.
- [9] National Pressure Ulcer Advisory Panel and the European Pressure Ulcer Advisory Panel (NPIAP/EPUAP). Prevention and treatment of pressure ulcers: clinical practice guideline. Washington DC: NPUAP; 2009. p. 169.
- [10] Schubert V. The influence of local heating on skin microcirculation in pressure ulcers, monitored by a combined laser Doppler and transcutaneous oxygen tension probe. *Clin Physiol* 2000;20:413–21. <https://doi.org/10.1046/j.1365-2281.2000.00275.x>.
- [11] Gelis A, Dupeyron A, Legros P, Benaim C, Pelissier J, Fattal C. Pressure ulcer risk factors in persons with SCI. Part I: acute and rehabilitation stages. *Spinal Cord* 2009;47:99–107. <https://doi.org/10.1038/sc.2008.107>.
- [12] Worsley P, Voegeli D. Back to basics: biophysical methods in tissue viability research. *JWC* 2013;22(8):434–9. <https://doi.org/10.12968/jowc.2013.22.8.434>.
- [13] Liu Liang Q. Sacral nerve stimulation: the effect on gluteal tissues in spinal cord injury. PhD thesis. UK: University College London; 2007.
- [14] National Spinal Cord Injury Statistical Centre (NSCISC). Annual report for the model spinal cord injury care systems. Model Spinal Cord Injury Care Systems. Birmingham, AL: NSCISC; July 2005. p. 120–1.
- [15] Marin J, Nixon J, Gorecki C. A systematic review of risk factors for the development and recurrence of PUs in people with spinal cord injuries. *Spinal Cord* 2013;51(7):522–7. <https://doi.org/10.1038/sc.2013.29>.
- [16] Dealey C, Posnett J, Walker A. The cost of PUs in the United Kingdom. *J Wound Care* 2012;21(6):261–2. <https://doi.org/10.12968/jowc.2012.21.6.261>.
- [17] Liu Liang Q, et al. A systematic review of electrical stimulation for pressure ulcer prevention and treatment in people with spinal cord injuries. *Journal of Spinal Cord Medicine* 2014;37(6):703–18. <https://doi.org/10.1179/2045772314Y.0000000226>.
- [18] Kruger EA, Pires M, Ngann Y, Sterling M, Rubayi S. Comprehensive management of pressure ulcers in spinal cord injury: current concepts and future trends. *The Journal of Spinal Cord Medicine* 2013;36(6):572–85. <https://doi.org/10.1179/2045772313Y.0000000093>.
- [19] Bogie KM, Nuseibeh I, Bader DL. Early progressive changes in tissue viability in the seated spinal cord injured subject. *Paraplegia* 1995;33(3):141–7. <https://doi.org/10.1038/sc.1995.31>.
- [20] Groah Suzanne L, et al. Prevention of pressure ulcers among people with spinal cord injury. A Systematic Review PM&R 2015;7(Issue 6):613–36. <https://doi.org/10.1016/j.pmrj.2014.11.014>.
- [21] Rintala DH, Garber SL, Friedman JD, Holmes SA. Preventing recurrent pressure ulcers in veterans with spinal cord injury: impact of a structured education and follow-up intervention. *Arch Phys Med Rehabil* 2008 Aug;89(8):1429–41. <https://doi.org/10.1016/j.apmr.2008.01.015>. PMID: 18674978.
- [22] Fogelberg DJ, Powell JM, Clark FA. The role of habit in recurrent pressure ulcers following spinal cord injury. *Scand J Occup Ther* 2016 Nov;23(6):467–76. <https://doi.org/10.3109/11038128.2015.1130170>.
- [23] King Rosemarie B, Porter Stacey L, Vertiz Kristen Balfanz. Preventive skin care beliefs of people with spinal cord injury. *Rehabilitation Nursing Journal* July 2008; 33(4):154–62. <https://doi.org/10.1002/j.2048-7940.2008>.
- [24] Bennell K, Nelligan RK, Schwartz S, et al. Behavior change text messages for home exercise adherence in knee osteoarthritis: randomized trial. *J Med Internet Res* 2020;22(9):e21749. <https://doi.org/10.2196/21749>. Published 2020 Sep. 28.
- [25] Finitis DJ, Pellowski JA, Johnson BT. Text message intervention designs to promote adherence to antiretroviral therapy (art): a meta-analysis of randomized controlled trials. *PLoS One* 2014 Feb 5;9(2):e8816626. <https://doi.org/10.1371/journal.pone.0088166>.
- [26] Haddad NS, Istepanian R, Philip N, Khazaal FA, Hamdan TA, Pickles T, Amso N, Gregory JW. A feasibility study of mobile phone text messaging to support education and management of type 2 diabetes in Iraq. *Diabetes Technol Therapeut* 2014 Jul;16(7):454–9. <https://doi.org/10.1089/dia.2013.027>.
- [27] Efrid J. Blocked randomization with randomly selected block sizes. *Int J Environ Res Publ Health* 2011;8(1):15–20. <https://doi.org/10.3390/ijerph8010015>.
- [28] Liu Liang Q, et al. The Development and assessment of reliability and validity of a questionnaire to measure concordance to 'pressure relief' regimen for pressure injury prevention in seated spinal cord injury. *J Tissue Viability* 2020;30(2):244–9. <https://doi.org/10.1016/j.jtv.2020.05.002>.
- [29] Broadbent E, Petrie KJ, Main J, Weinman J. The brief illness perception questionnaire. *J Psychosom Res* 2006;60(6):631–7. <https://doi.org/10.1016/j.jpsychores.2005.10.020>.
- [30] Cogan AM, Blanchard J, Garber SL, Vigen CL, Carlson M, Clark FA. Systematic review of behavioral and educational interventions to prevent pressure ulcers in adults with spinal cord injury. *Clin Rehabil* 2017 Jul;31(7):871–80. <https://doi.org/10.1177/0269215516660855>.
- [31] Robineau S, Nicolas B, Mathieu L, Duruflé A, Leblong E, Fraudet B, et al. Assessing the impact of a patient education programme on pressure ulcer prevention in patients with spinal cord injuries. *J Tissue Viability* 2019;28(4):167–72. <https://doi.org/10.1016/j.jtv.2019.06.001>.
- [32] Kim JY, Cho E. Evaluation of a self-efficacy enhancement programme to prevent pressure ulcers in patients with a spinal cord injury. *Jpn J Nurs Sci* 2017;14(1):76–86. <https://doi.org/10.1111/jjns.12136>.
- [33] Wood AM, White IR, Thompson SG. Are missing outcome data adequately handled? A review of published randomized controlled trials in major medical journals. *Clin Trials* 2004;1:368–76. <https://doi.org/10.1191/1740774504cn0320a>.
- [34] Brueton VC, Tierney J, Stenning S, et al. Strategies to improve retention in randomised trials. *Cochrane Database Syst Rev* 2013;12:MR000032. <https://doi.org/10.1002/14651858>. Published 2013 Dec 3.