第 47 卷 第 10 期
2020 年 10 月

湖南大学学报（自然科学版）
Journal of Hunan University (Natural Sciences)

Vol. 47. No. 10.
Oct. 2020

Digital Technology: Innovation for Malnutrition Prevention among Bedridden Elderly Patients Receiving Home-Based Palliative Care

Jinpitcha Mamom

Faculty of Nursing, Excellence Center in Creative Engineering Design and Development, Thammasat University, Bangkok, Thailand

Abstract: In this innovative development design study, we aimed at examining the effects of digital technology in its use as a mobile nutrition application on the nutritional status and calorie intake for 60 Thai bedridden elderly patients receiving home-based palliative care. The elderly bedridden patients were randomized into two groups, a control group receiving routine care and an experimental group using the anti-malnutrition application. The data from a personal information record, the assessment form for body mass index, calorie intake calculation form and the record form for blood albumin levels were analyzed using descriptive statistics and t-test. The results showed that the calorie intake, blood albumin levels, and body mass index of the experimental group were significantly higher than those of the control group ($p < .05$). The results suggest that this application could solve the malnutrition problem in elderly bedridden patients and significantly enhance their caregivers' satisfaction. This mobile application for appropriate nutrition and calorie intake calculations can be used as a significant practical, effective health-associated innovation that promotes patients' nutritional status. It facilitates the monitoring of patients' nutritional status. It also provides caregivers with the knowledge and understanding they need to improve the home-based palliative care of the elderly bedridden patients, especially in the health crisis of the COVID-19 era.

Keywords: Digital technology, Elderly, Home-based Palliative care, Pressure ulcer, COVID-19 era.

數字技術：臥床不起的老年患者接受家庭姑息治療的營養不良預防創新

摘要：在這項創新的開發設計研究中，我們旨在檢驗數字技術作為移動營養應用的使用對 60 位接受臥床姑息治療的泰國臥床不起的老年患者的營養狀況和卡路里攝入的影響。參與者，即臥床不起的老年患者，被隨機分為兩組，對照組接受常規護理，實驗組採用抗營養不良應用。使用描述性統計和 t 檢驗分析了個人信息記錄，體重指數評估表，卡路里攝入量計算表和血白蛋白水平記錄表中的數據。結果顯示，實驗組的卡路里攝入量，血白蛋白水平和體重指數顯著高於對照組（$p < .05$）。結果表明，該應用程序可以解決臥床老年患者的營養不良問題，並顯著提高其護理人員的滿意度。此移動應用程序可進行適當的營養和卡路里攝入量計算，可作為一項重要的實用，有效的健康相關創新，來提高患者的營養狀況。它有助於監測患者的營養狀況。它還為護理人員提供了他們需要的知識和理解，以改善臥床不起的老年患者的家庭姑息治療，尤其是在新冠肺炎時代的健康危機中。

關鍵字：數字技術，老年人，家庭姑息治療，壓瘡，新冠肺炎時代.

1. Introduction

Many countries face a population challenge because of the enormous population growth of their elderly [1] [2]. This part of the population is likely to increase by more than 50% between 2015 and 2030. By 2050, the proportion of the elderly around the world will double.

Received (date):

Fund Project: Creative Engineering Design & Development, CED2, and Research Funding Faculty of Nursing. Thammasat University.

About the author: Jinpitcha Mamom, Faculty of Nursing, Excellence Center in Creative Engineering Design and Development, Thammasat University, Thailand

Corresponding author Jinpitcha Mamom, jinpitcha@nurse.tu.ac.th

[3] Like other countries in Southeast Asia, Thailand has successfully increased care quality for its elderly and some social, economic, and health problems in the population1 [1], [4]. Malnutrition is one of the severe health problems and thereby increases the mortality rate of the elderly [2], [5]. Malnutrition is a condition that dangerously affects the body from a clinical perspective. Malnutrition is a state of inadequate nutritional status. It assumes a deficient dietary intake, poor appetite, and weight loss that causes adverse effects on physiological functions and other clinical results, such as decreased quality of life [6]. Various adverse health outcomes are associated with a nutrition disorder in the elderly. These include functional impairment, low quality of life of both the patient and caregivers, increased risk of infections, electrolyte imbalances, anemia, and muscle depletion. This disorder is also associated with falls and undernourishment, especially among the elderly population receiving palliative care. Despite these consequences, some literature studies have revealed that malnutrition remains under-recognized among the elderly receiving home-based palliative care. There is no ordinary procedure available for appropriate documentation because of the inadequate awareness and the caregivers' too high workload [7]. For that reason, the initial finding of malnutrition and nutritional improvement is of considerable importance to prevent these associated dangerous results [8]. This situation strongly indicates the need for an intervention dedicated to managing elderly bedridden patients' nutritional problems. Inadequate dietary status became a significant risk factor for prolonged wound healing times. Therefore, improving the nutritional quality of elderly bedridden patients is critical in their overall wellness state [9].

Currently, digital technology in the form of mobile applications is becoming increasingly significant because of its advantages in improving the quality of life. Consequently, mobile became a vital part of daily living for almost everyone. There are presently no applications that calculate personalized daily calorie needs or offer guidance on specific nutrients needed to promote elderly bedridden patients' nutritional status receiving palliative care. Mobile applications enhance caregivers' knowledge in illness management and complication prevention for palliative patients. They will eventually bring about extensive changes in the healthcare system.

2. Objective

This experimental research design examined the effects of the anti-malnutrition mobile application on the nutritional status and calorie intake of elderly bedridden patients from June 2016 to May 2017.

3. Methods

3.1. Participants

The subjects were elderly patients with a high risk of malnutrition. Specifically, these patients'' caregivers had mobile phones capable of accessing the application. The inclusion criteria were as follows: 1) Patients with a high risk of malnutrition who received home-based palliative care; 2) Patients for whom physicians ordered nasogastric feeding, and 3) Caregivers who were capable of using the application and communicating in Thai correctly.

Sixty participants were divided into 30 subjects making up the experimental group and 30 subjects making up the control group using matched pairs based on gender, age, and body mass index (BMI) scores.

3.2. Research Instrument

Nutritional status evaluation was performed through serum albumin level determination by using 5 milliliters of blood serum according to the standard method [4] and was done by the investigator on the 1st day and 2nd month of enrollment.

The anti-malnutrition mobile application for calculating the required daily calorie intake is a specialized program that the caregivers can access to calculate the precise amount of calories per day. Both the iOS and Android platforms were chosen to create the application. This application demonstrated to be a significant device for caregivers. It facilitated the calculations of the patients' appropriate daily energy and food intake needed to improve their nutritional status. The instrument's content validity was assessed by a physician, two Advanced Practice Nurses, and two application engineers. The application consisted of the following steps:

Step 1: Fill out individual information, including age, weight, and height, so that the program can compute the patient's energy each day.

Step 2: The program calculated the nutrient requirements in each nutrients so that the patients would receive all needed nutrients. The system made use of the equation for total energy expenditure (TEE) = BEE x 1.2 x stress factor. In males, BEE = 66 + (13.7 x weight [kg]) + (5 x height [cm]) - (6.8 x age); in females, BEE = 655 + (9.6 x weight [kg]) + 1.7 x height [cm]) – (4.7 x age).

Step 3: The program presented the quantity of nutrients as calculated in Step 2. The system then gave the food categories that provide the estimated number of calories needed per day.

3.3. Research Data Analysis

SPSS version 22.0 was used to manage and analyze the data. The chi-square test was used to assess the significance of categorical variables. A T-test was done to compare the serum albumin levels and administer and calculate the number of calories consumed per day,

both within and between groups. A p-value < .05 was considered to be statistically significant.

4. Data Collection Procedure

Sixty participants were randomly assigned to the experimental and control groups, using the SPSS version 22.0 random-number generator for an equivalent participant total in each group (30 per group).

In the experimental groups, the researchers informed them of the overall sign and symptoms of the complications arising from bedridden status and nutrition care procedures. They described how they could calculate their caloric intake each day by use of this application. The researchers then gave a demonstration and a return demonstration until they were sure that the caregivers could access and use the application properly. Meanwhile, in the control group, the researchers informed them of the overall sign and symptoms of the complications arising from bedridden status and nutrition care procedures. They explained how they calculate their caloric intake each day according to the manual-energy and nutrient calculation booklet. It is the same form that they had received from the nutritionists in the hospital, who gave a demonstration and a return demonstration until the researchers were sure that the caregivers could calculate the energy and nutrients appropriately.

5. Result

The sample size was 60 subjects between 60 and 91 years of age. The average age was 65.48 years (SD = 6.26), as shown in Table 1.

Table 1 Characteristic of the participants

	Experimental (n = 30)	**Control (n = 30)**
Age (years)	67.13 ± 7.96	63.83 ± 3.27
Gender (male/female)	4/26	6/24
Body height (cm)	157.27 ± 0.08	156.00 ± 0.76
Body weight (kg)	49.43 ± 5.18	49.13 ± 4.61
Body mass index (kg/m^2)	20.01 ± 1.85	20.20 ± 1.56

Part 2: Comparison of the serum albumin levels between groups indicated that the serum albumin levels of the experimental group using the mobile nutrition application were significantly higher than those of the control group receiving conventional care at the .05 level, as shown in Table 2.

Table 2 The serum albumin levels between groups on the first day and the 2nd month

	Study Group	**n**	**Mean**	**SD**
Before	Experimental	30	2.59	0.32
	Control	30	2.53	0.25
After	Experimental	30	2.77	0.42
	Control	30	2.50	0.36

Table 3 The difference between administered and calculated calories per day in both study groups

	Experimental (n = 30)	**Control (n = 30)**
Mean calories per day [kcal]	1530 ± 160	1540 ± 150
Calories (administered–calculated) [kcal/day]	15 ± 110*	-50 ± 125*

*p<.05

Part 3: Comparison of the differences between administered and calculated calories per day of the groups indicated that the control group showed a negative difference of administered and calculated calories per day, whereas the intervention group showed a positive difference (Z = 3.655; p < .05), as shown in Table 3.

6. Discussion

The participants were mostly female (83.3%), and the mean age was 65.48 years, while their age range was from 60 to 93 years. These findings agree with the previous studies [10-15], which revealed that home-based bedridden patients were elderly and were mostly female.

Advanced technology, mainly digital technology in the form of a mobile nutrition application, could support the malnutrition problem in elderly bedridden patients receiving home-based care. Those concerned over the individual daily calorie intake can make use of this mobile nutrition application. The calculation of the needed individual daily basal metabolic rate is calculated from the formula based on personal body weight, height, age, and gender through the use of the created mobile application. The basal metabolic rate is calculated to evaluate the daily energy requirement by an activity factor. Factor 1.2 was chosen because all samples were bedridden condition [4], [9], [10], [11]. Also, the administered calories and valued need for total calorie requirements were computed for individual participants. [10] The results showed that the calorie intake, serum albumin levels, and BMI of the experimental group were significantly higher than those of the control group (p < .05). These results correlate well with many studies [11-14]. However, most studies have failed to demonstrate that nutritional improvement would reduce complications, such as pressure injuries.[4], [11], [13], [14], [15]. We found that the application features still required continuous development, such as the duration and the speed of access to the program.

This mobile application, healthcare software technology, for calculating the required daily calorie intake differs from other general mobile applications because it can calculate the necessary calories per day based on individual characteristics and illness

conditions. The program could calculate the needed daily calories and nutrient requirements so that patients receive absolute nutrients every day. On this basis, caregivers could prepare appropriate and vital nutrients for patients according to individual needs, which would affect the serum albumin levels that, in turn, affect the nutritional status. It was observed that the serum albumin levels of the 30 subjects using this anti-malnutrition application for calculating the required daily calorie intake increased from 2.59 to 2.77 mg% after their caregivers used this application. As compared to the subjects using the routine nutrient calculation guide, the average serum albumin level of the subjects using the application for calculating the required daily food intake was 2.77 mg%. In comparison, that of the subjects using the routine nutrient calculation guide was 2.50 mg%.

The significance of this anti-malnutrition mobile-application, based on gaining and gathering evidence-based knowledge, was the improvement in nutrition status through a nursing intervention based on the calculation of individually needed calories. [15] These findings result from the fact that the control group received nutrition management by using the manual provided by a nutritionist as ordinary routine care. In contrast, the intervention group used this application to calculate the needed calorie intake per day during the intervention period of 8 weeks. The experimental and control groups were administered 15 ± 110 and -50 ± 125 kcal/ day, respectively, indicating that the experimental group received complete nutrition and calorie intake. In contrast, the control group tended to receive inadequate nutrients and calories for their condition. The research has shown patients' efficacy and safety in obtaining all the necessary nutrients and calories per day. In contrast, patients who receive insufficient nutrients will eventually develop dangerous complications more than conventional treatment. This mobile application is considered to have great potential, especially for palliative care, to support patients' self-management in many ways. The use of mobile health applications in clinical practice changes the relationship between patients, family, physicians, and healthcare providers.

7. Conclusions

Mobile health apps are becoming digital interventions in home-based clinical practice. They are about to undergo a digital transformation soon. The findings suggest that this application's advantage could solve and prevent malnutrition issues in elderly bedridden patients and significantly enhance the caregivers' satisfaction for preparing the appropriate daily diet. This easy software application is precious for proper nutrition and calorie intake calculations. It prevents complication-related nutrition. Furthermore, it is a practical health-associated innovation that promotes monitoring of the patients' nutritional status. Mobile health apps provide caregivers with sufficient knowledge and understanding to improve the home-based palliative care of elderly bedridden patients during the health crisis of the COVID-19 era.

References

[1] TAKAHASHI Y., SAITO K., MATSUNAGA T., *et al.* Relationship between dynamic trunk balance and the mini-balance evaluation systems test in elderly women. *International Journal of Physical Medicine & Rehabilitation*, 2020, 8: 534.

[2] KOMICI K., VITALE D.F., MANCINI A., *et al.* Impact of Mmalnutrition on long-term mortality in elderly patients with acute myocardial infarction. *Nutrients*, 2019, 11(2):224.

[3] TAMANG M. K., YADAV U.N., HOSSEINZADEH H., *et al.* Nutritional assessment and factors associated with Mmalnutrition among the elderly population of Nepal: a cross-sectional study. *BMC Research Notes*, 2019, 12(1):246.

[4] MAMOM J. The effects of a community-based discharge-planning model for continuing pressure ulcer care on wound healing rates, nutritional status, and infection rates of elderly patients in Thailand. *Songklanakarin Journal of Science & Technology*, 2017, 39(3):341-346. https://doi.org/10.14456/sjst-psu.2017.37

[5] BATSIS J. A. Obesity in the older adult. *Journal of Nutrition in Gerontology and Geriatrics*, 2019, 38(1):1-5. https://doi.org/10.1080/21551197.2018.1564197

[6] MARTIN P. M., AGUDO F. R., MEDINA J. A., et al. Effectiveness of an oral diabetes-specific supplement on nutritional status, metabolic control, quality or life, and functional status in elderly patients. A multicentre study. *Clinical Nutrition*, 2019, 38(3): 1253-1261.

[7] TANA C., LAURETANI F., TICINESI A., *et al.* Impact of nutritional status on caregiver burden of elderly outpatients. A cross-sectional study. *Nutrients*, 2019, 11(2):281.

[8] KLANJSEK P., PAJNKIHAR M., VARDA N.M., *et al.* Screening and assessment tools for early detection of Mmalnutrition in hospitalized children: a systematic review of validation studies. *BMJ Open*. 2019, 9(5):e025444.

[9] SAGHALEINI S.H., DEHGHAN K., SHADVAR K., *et al.* Pressure ulcer and nutrition. Indian Journal of Critical Care Medicine, 2018, 22(4):283.

[10] GE Lixia, YAP Chun Wei; HENG, Bee Hoon Association of nutritional status with physical function and disability in community-dwelling older adults: A longitudinal data analysis. *Journal of Nutrition in Gerontology and Geriatrics*, 2020, 39(4): 1-12. https://doi.org/10.1080/21551197.2020.1725711

[11] MAMOM J., RUNGREUNGDUAYBOON B. Design and development of lateral tilting mechanical bed for rural bedridden patients in Thailand. *Journal of Hunan University Natural Sciences*, 2020, 47(9). http://jonuns.com/index.php/journal/article/view/440

[12] SCHMIDT B., BOLTZMAN M., KRAUSS J. K., *et al.* Standardized nutritional supply versus individual nutritional assessment: Impact on weight changes, complications and functional outcome from neurological early rehabilitation. *Clinical Nutrition*, 2020, 39.4: 1225-1233. https://doi.org/10.1016/j.clnu.2019.05.013

[13] HANTSOO L, CRINITI S, KHAN A, *et al.* A mobile application for monitoring and management of depressed mood in a vulnerable pregnant population. *Psychiatric Services*, 2018, 69(1): 104-107.
[14] ZHAO J., FREEMAN B., LI M. Can mobile phone apps influence people's health behavior change? An evidence review. *Journal of Medical Internet Research*, 2016, 18(11):e287.
[15] MAMOM J., WINAIPRASERT P. The effectiveness of a mobile nutrition application to promote the nutritional status and wound healing rate in patients with pressure ulcers receiving long-term care in Thailand. *HSOA Journal of Practical and Professional Nursing*, 2019:S1002. http://www.heraldopenaccess.us/fulltext/Practical-&-Professional-Nursing/The-Effectiveness-of-a-Mobile-Nutrition-Application-to-Promote-the-Nutritional-Status.pdf. https://doi.org/10.24966/PPN-5681/S1002.

参考文:

[1]TAKAHASHI Y., SAITO K., MATSUNAGA T., 等人。高橋 Y.，齋藤 K.，松浦 T.等。老年婦女的軀幹動態平衡與小型平衡評估系統測試之間的關係。國際物理醫學與康復雜誌，2020，8：534。

[2] KOMICI K.，VITALE D.F.，MANCINI A.等。營養不良對老年急性心肌梗死患者長期死亡率的影響。營養素，2019，11（2）：224。

[3] TAMANG M.K. ， YADAV U.N. ， HOSSEINZADEH H. 等。尼泊爾老年人口的營養評估和與營養不良有關的因素：一項橫斷面研究。BMC 研究筆記，2019，12（1）：246。

[4] MAMOM J. 基於社區的出院計劃模型，用於持續性壓瘡護理對泰國老年人的傷口癒合率，營養狀況和感染率的影響。 Songklanakarin 科技雜誌，2017，39（3）：341-346。 https://doi.org/10.14456/sjst-psu.2017.37

[5] BATSIS J. A. 成年人肥胖。營養學報，2019，38（1）：1-5。 https://doi.org/10.1080/21551197. 2018. 1564197

[6] MARTIN P. M.，AGUDO F. R.，MEDINA J. A. 等。特定於口服糖尿病的補充劑對老年患者的營養狀況，代謝控制，質量或生活以及功能狀況的有效性。多中心研究。臨床營養，2019，38（3）：1253-1261。

[7] TANA C.，LAURETANI F.，TICINESI A. 等。營養狀況對老年門診護理人員負擔的影響。橫斷面研究。營養素，2019，11（2）：281。

[8] KLANJSEK P.，PAJNKIHAR M.，VARDA N.M. 等。早期發現住院兒童營養不良的篩查和評估工具：對驗證研究的系統回顧。 BMJ 開放。 2019，9（5）：e025444。

[9] SAGHALEINI S. H. ， DEHGHAN K. ， SHADVAR K. 等。壓瘡和營養。印度重症醫學雜誌，2018，22（4）：283。

[10] 葛立霞，葉春偉； HENG，Bee Hoon 社區老年人的營養狀況與身體機能和殘疾的聯繫：縱向數據分析。營養學報，2020，39（4）：1-12。 https://doi.org/10.1080/21551197.2020.1725711

[11] MAMOM J.，RUNGREUNGDUAYBOON B。面向泰國農村臥床患者的側傾式機械床的設計和開發。湖南大學學報（自然科學版），2020，47（9). http://jonuns.com/index.php/journal/article/view/440

[12] SCHMIDT B.，BOLTZMAN M.，KRAUSS J. K.等人。標準化營養供應與個人營養評估：對神經早期康復對體重變化，並發症和功能結局的影響。臨床營養，2020，39.4：1225-1233。 https://doi.org/10.1016/j.clnu.2019.05.013

[13] HANTSOO L，CRINITI S，KHAN A 等。一個移動應用程序，用於監視和管理易受傷害的孕婦的抑鬱情緒。精神科服務，2018，69（1）：104-107。

[14] ZHAO J., FREEMAN B., LI M. 手機應用程序能否影響人們的健康行為改變？證據審查。醫學互聯網研究雜誌，2016，18（11）：e287。

[15] MAMOM J.，WINAIPRASERTP。在泰國接受長期護理的壓力性潰瘍患者中，移動營養應用對改善營養狀況和傷口癒合率的有效性。 HSOA 實用和專業護理雜誌，2019：S1002