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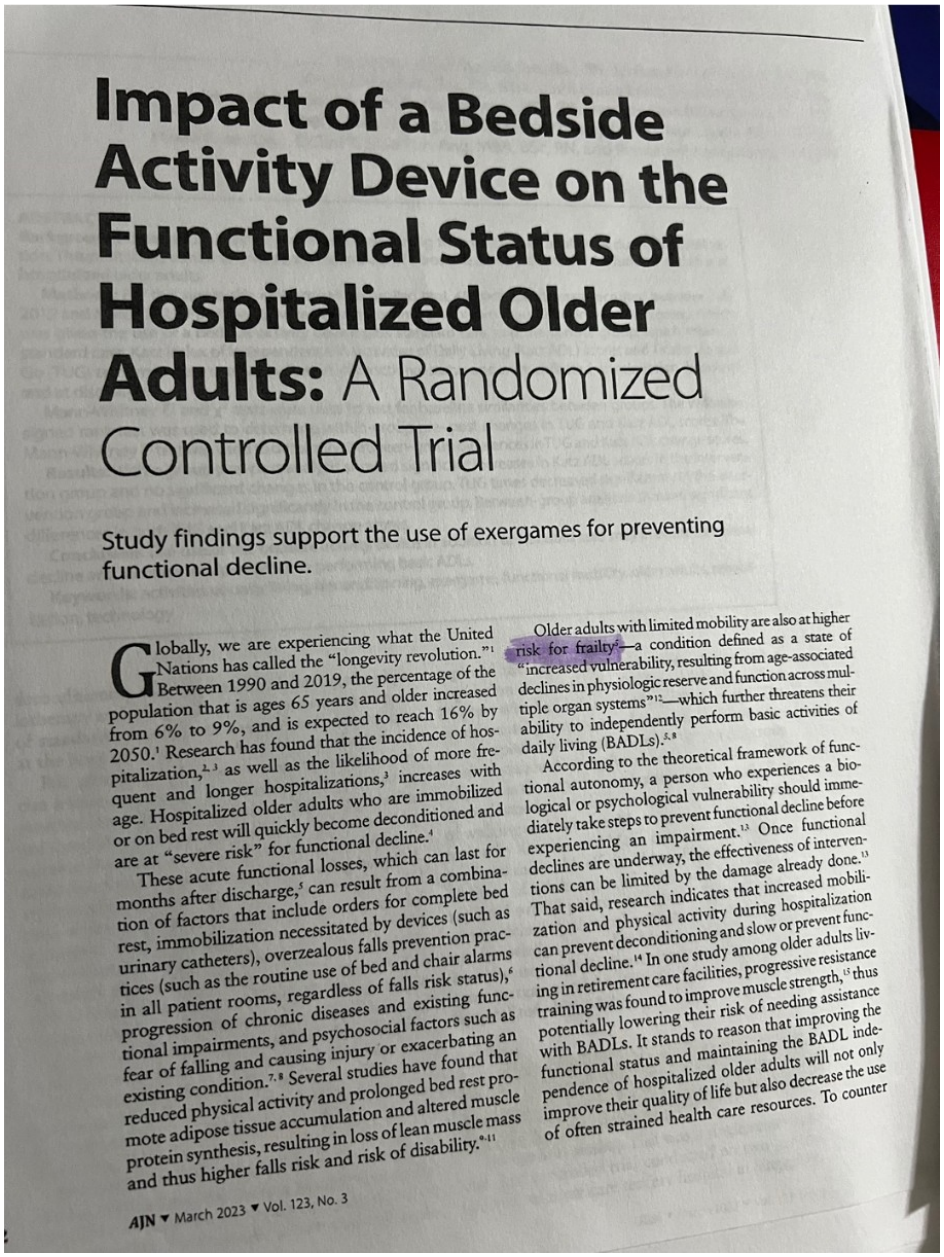
3.(1) multiple choice questions and answers per poster that reflects a key point from the article.
Older adults with limited mobility are at higher risk for?
A.Frailty
B. Strength
C.Healthiness
D.Freebleness
4.Page and Paragraph number to locate the answers to multiple choice questions.
Page. 22 paragraph. 3

Phase I- Submit to EBP Poster-phase 1 dropbox in Edvance360 by 2200 on 2/4/24:	**Yes (2)**	**No (0)**
Poster title	2	
(1) multiple choice question and answer that reflects a key point from the article	1	
Copy of the full article with answer to multiple choice question highlighted in yellow	2	
Reference listed in APA format (7th edition)	1	

You did a nice job with phase 1. The rubric for phase 1 is above along with the points you received for this phase. For every correction made you will receive 1 point back for each at the end of all the phases. I like your title. You did a nice job writing your question, however it should be a take home point from your article versus the purpose statement. Please come up with a new question and resubmit. Overall your APA format was well done. I made a few changes to your reference including correcting your indentation in the reference in red. A One author needed an addition letter and a few areas needed to be deleted. Please use this

reference for your PowerPoint and poster. Overall you did a great job! I cannot wait to see your poster! KA



Impact of a Bedside Activity Device on the Functional Status of Hospitalized Older Adults: A Randomized Controlled Trial

Study findings support the use of exergames for preventing functional decline.

Globally, we are experiencing what the United Nations has called the "longevity revolution."[1] Between 1990 and 2019, the percentage of the population that is ages 65 years and older increased from 6% to 9%, and is expected to reach 16% by 2050.[1] Research has found that the incidence of hospitalization,[2,3] as well as the likelihood of more frequent and longer hospitalizations,[3] increases with age. Hospitalized older adults who are immobilized or on bed rest will quickly become deconditioned and are at "severe risk" for functional decline.[4]

These acute functional losses, which can last for months after discharge,[5] can result from a combination of factors that include orders for complete bed rest, immobilization necessitated by devices (such as urinary catheters), overzealous falls prevention practices (such as the routine use of bed and chair alarms in all patient rooms, regardless of falls risk status),[6] progression of chronic diseases and existing functional impairments, and psychosocial factors such as fear of falling and causing injury or exacerbating an existing condition.[7,8] Several studies have found that reduced physical activity and prolonged bed rest promote adipose tissue accumulation and altered muscle protein synthesis, resulting in loss of lean muscle mass and thus higher falls risk and risk of disability.[9-11]

Older adults with limited mobility are also at higher risk for frailty[2]—a condition defined as a state of "increased vulnerability, resulting from age-associated declines in physiologic reserve and function across multiple organ systems"[12]—which further threatens their ability to independently perform basic activities of daily living (BADLs).[5,8]

According to the theoretical framework of functional autonomy, a person who experiences a biological or psychological vulnerability should immediately take steps to prevent functional decline before experiencing an impairment.[13] Once functional declines are underway, the effectiveness of interventions can be limited by the damage already done.[13] That said, research indicates that increased mobilization and physical activity during hospitalization can prevent deconditioning and slow or prevent functional decline.[14] In one study among older adults living in retirement care facilities, progressive resistance training was found to improve muscle strength,[15] thus potentially lowering their risk of needing assistance with BADLs. It stands to reason that improving the functional status and maintaining the BADL independence of hospitalized older adults will not only improve their quality of life but also decrease the use of often strained health care resources. To counter

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ABSTRACT

Background: Older adults may have difficulty maintaining their functional capabilities during hospitalization. This pilot study aimed to investigate the impact of a bedside activity device on the functional status of hospitalized older adults.

Methods: For this single-site randomized controlled trial, 48 participants were recruited between July 2019 and March 2021. Participants were randomized into one of two groups: the intervention group, which was given the use of a bedside activity device plus standard care, and the control group, which received standard care. Katz Index of Independence in Activities of Daily Living (Katz ADL) scores and Timed Up and Go (TUG) test times were used as indicators of functional status and were collected on admission (baseline) and at discharge.

Mann-Whitney U and χ^2 tests were used to test for baseline similarities between groups. The Wilcoxon signed rank test was used to determine within-group pre–post changes in TUG and Katz ADL scores. The Mann-Whitney U test was used to determine between-group differences in TUG and Katz ADL change scores.

Results: Within-group pre–post analysis showed significant increases in Katz ADL scores in the intervention group and no significant changes in the control group. TUG times decreased significantly in the intervention group and increased significantly in the control group. Between-group analyses showed significant differences in both TUG and Katz ADL change scores.

Conclusion: The use of the bedside activity device in addition to standard care may prevent functional decline and increase independence in performing basic ADLs.

Keywords: activities of daily living, deconditioning, exergame, functional mobility, older adults, rehabilitation, technology

deconditioning and functional declines, regular physiotherapy and occupational therapy sessions are part of standard treatment for hospitalized older adults at the hospital where our study was conducted.

But scheduled, physiotherapist-supervised exercise sessions alone may be insufficient to prevent or slow the rate of functional decline. Other approaches are needed to encourage further physical activity outside the therapy room. Environmental innovations that foster increased mobility during hospitalization might be one way to do this. One potential tool worth exploring is a bedside activity device equipped with "exergames"—interactive video games that incorporate physical exercise, tracking the user's physical reactions and movements[16]—as well as safety features to prevent falls. The gamified element aims to make exercising seem less daunting and more fun than just resting in bed; the safety features aim to ensure the user's safety and ease providers' concerns about falls. It's likely that exergames could help to offset the declines in muscle strength and motor skills that are likely to result from complete bed rest.

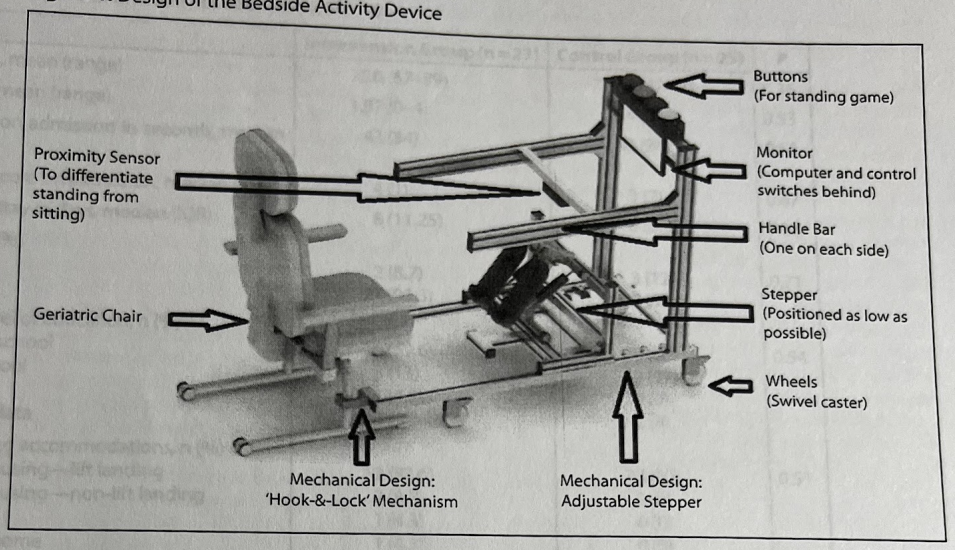
Few studies have investigated the use of exergames among older adults. But there is some evidence that gamified rehabilitation interventions are beneficial for this population. For example, Szturm and colleagues explored the use of interactive video games with a population of community-dwelling adults ages 65 to 85 years who had balance and mobility issues.[17] The experimental group received dynamic balance exercises coupled with exergames, while the control group received standard strength and balance exercises. Participants in the experimental group either matched or outperformed controls on several outcome measures of walking and balance. More recently, a systematic review by Koivisto and Malik considered studies that explored the health effects of gamification with populations of adults ages 55 years and older.[18] They reported overall positive effects in 13 health-related areas, including physical activity and balance.[18] To our knowledge, no studies have specifically explored how the use of a bedside activity device that incorporates exergames might affect the functional status of hospitalized older adults.

METHODS

Aim. The aim of this pilot study was to evaluate the impact of a bedside activity device that incorporated exergames on the functional status of hospitalized adults ages 65 years and older.

Design and setting. This was a single-center randomized controlled trial conducted on two general units at an acute care tertiary hospital in Singapore.

Figure 1. Design of the Bedside Activity Device



The study was approved by the hospital's institutional review board before recruitment and data collection began.

Sample. Participants were recruited between July 2019 and March 2021 on the two units using convenience sampling. The inclusion criteria were being a hospitalized adult 65 years of age or older, being community ambulant (with or without gait aids) prior to admission, having no medical contraindications for physical exertion, and being cognitively intact (having no diagnosed condition that might affect cognition and being able to communicate coherently with a research team member during recruitment). Patients who were enrolled in another rehabilitation program or were to be discharged or transferred out of the unit within the next three days were excluded. Written informed consent was obtained from all participants.

Participant randomization was conducted using a numerical table held in confidence by the research coordinator (one of us, NLA). In the table, the numbers one to 48 were randomly sorted into two columns: intervention and control. Upon recruitment, each participant was assigned a number, after which the research coordinator, referring to the table, revealed that participant's allocation to the clinical members of the research team. Participants in the control group received standard care, which may or may not have included physiotherapy interventions. Those in the intervention group received standard care and also used the bedside activity device on a daily basis.

Intervention. A bedside activity device was codesigned by two engineers from an academic institution who specialize in product development and by nurses (PEMF, XYCL, FA, SYA) and physiotherapists (CCH, ST, HKO) providing input on safety requirements. This device (see Figure 1) was designed to be attached to one of the geriatric chairs currently in use at the hospital and was shared by the two study units. Stepping and sit-to-stand exercises were incorporated on the physiotherapists' recommendation, as these are considered essential task-oriented rehabilitation activities[19] and can be expected to build the strength required for BADLs. Two exergames were installed on the device console: a slot machine game and a color-matching game. The games were designed by the team engineers to involve stepping and sit-to-stand movements. In the slot machine game, increasing the number of steps taken can increase the participant's potential score on the slot machine. The stepper-to-chair distance can be adjusted for optimum positioning based on the participant's height. In the color-matching game, the console displays a series of fruit images (a lemon, for example). In order to score, the participant has to stand up and press the correct color button (in this case, yellow).

Safety features were also incorporated, such that participants could perform the exercises independently. The hook-and-lock attachment system allows the device to be securely fastened to the chair, ensuring stability during use. Adjustable handlebars offer further support within easy reach, as needed. Once

Table 1. Participant Characteristics at Baseline, N = 48

Variable	Intervention Group (n = 23)	Control Group (n = 25)	*P*
Age, years, mean (range)	75.6 (67–89)	77.38 (67–90)	0.36
FCI score, mean (range)	1.57 (0–4)	1.4 (0–5)	0.53
TUG time on admission in seconds, median (IQR)	43 (34)	43 (34)	0.54
Katz ADL score on admission, median (IQR)	4 (1)	3 (2)	0.47
Length of stay in days, median (IQR)	8 (11.25)	8 (8.5)	0.35
Gender, n (%)			
Male	2 (8.7)	3 (12)	0.71
Female	21 (91.3)	22 (88)	
Highest level of education, n (%)			
Primary school	16 (69.6)	20 (80)	0.54
High school	3 (13)	3 (12)	
Tertiary	1 (4.3)	0 (0)	
Missing data	3 (13)	2 (8)	
Type of living accommodations, n (%)			
Public housing—lift landing	19 (82.6)	23 (92)	0.51
Public housing—non-lift landing	2 (8.7)	2 (8)	
Private	1 (4.3)	0 (0)	
Nursing home	1 (4.3)	0 (0)	
Living situation, n (%)			
Home alone	2 (8.7)	2 (8)	0.99
With family	19 (82.6)	21 (84)	
With others	2 (8.7)	2 (8)	
Caregiver, n (%)			
Yes, paid helper	2 (8.7)	4 (16)	0.45
Yes, family member	13 (56.5)	16 (64)	
No	8 (34.8)	5 (20)	

FCI = Functional Comorbidity Index; IQR = interquartile range; Katz ADL = Katz Index of Independence in Activities of Daily Living; TUG = Timed Up and Go.

Note: Because of rounding, some percentages may not sum to 100%.

the device was completed, it was evaluated by the hospital's biomedical engineering team and approved for use with patients.

Upon recruitment, participants in the intervention group received education from a research team member on the use of the bedside activity device and then were observed for one session. For subsequent sessions, the unit nurses brought the device to the patient's room and attached it to the geriatric chair; the patient could then use the device unsupervised. On both units, nurses who were part of the research team were available to provide additional support when needed. Patients were allowed to use the chair for as long as they wished, in order to mimic a real-life, self-directed exercise session.

Data collection. Sociodemographic data were collected, including the participant's date of birth, gender, type of living accommodation, caregiver presence, and highest level of education. General health status was assessed using the Functional Comorbidity Index (FCI). The FCI is an 18-item list of possible diagnoses: arthritis, osteoporosis, asthma, chronic obstructive pulmonary disease or acute respiratory distress syndrome, angina, congestive heart failure or heart disease, heart attack, neurological disease, stroke or transient ischemic attack, diabetes, peripheral vascular disease, upper gastrointestinal disease, depression, anxiety or panic disorder, visual impairment, hearing impairment, degenerative disk disease, and obesity or body mass index greater than 30.[20] One point is given for each diagnosis present, and points are summed for the total score.

The Timed Up and Go (TUG) test was used to assess each participant's mobility.[21] The test, which is timed in seconds, involves asking a person seated in a standard armchair to rise to standing, walk 10 feet

showed significant improvement in Katz ADL scores. More traditional mobility programs (twice-daily walking regimens for hospitalized older adults, for example) have reportedly helped maintain or improve BADL independence and could potentially reduce a patient's reliance on caregivers.[6] But as Liu and colleagues have noted, the current use of rote, non-task-oriented exercises "performed in a gym-like setting, outside the context of home" makes it difficult for patients to see how exercise affects the ability to perform BADLs.[29] Because our device incorporates exergames that target specific muscle groups and movements needed for BADLs, it's more likely to foster such understanding.

In our study, the control group had significantly longer TUG_D than TUG_A. This suggests that standard care was not sufficient to prevent functional decline. The finding further supports what we already know: older adults who are largely or completely immobilized during hospitalization quickly become deconditioned.[4]

Given that functional decline during and after hospitalization has been associated with increased risks of falls, prolonged hospitalization, readmission, frailty, and mortality,[14] as well as the predicted increase in the older patient population, it's crucial that we develop cost-effective interventions to promote independent physical activity among hospitalized older adults. In a recent study of 370 hospitalized very old adults, Martínez-Velilla and colleagues explored the impact of a multicomponent intervention consisting of low-impact resistance, balance, and mobility exercises, performed with and without supervision.[30] Standard, commercially available exercise equipment was used and exercises were tailored to each patient. The intervention was effective in reversing deconditioning and improving functional status during hospitalization; cognitive benefits were also noted. Although that study didn't explore gamification, it did take a more targeted approach to promoting physical activity among hospitalized older adults.

Novel and innovative solutions to the problems of deconditioning and functional decline during hospitalization could empower patients to take the initiative in their recovery. Gamified bedside activity devices that allow patients to safely exercise at will and without supervision could also free up providers' time, conserving valuable labor resources. That potential benefit has particular importance for the current era, with health care labor shortages and the rising prevalence of many chronic diseases making it more difficult to address the needs of aging populations.[31-33]

In gamifying the bedside activity device, we sought to encourage increased physical activity by adding an element of fun.

Limitations. This study had several limitations. First, the small sample size restricted the generalizability of the results. Replicating this study on a larger scale among hospitalized older adults on diverse units would address this. Future studies should also consider exploring the impact of a variety of exergames designed to encourage exercise and improve balance, gross and fine motor control skills, and cognition in older adults.

Second, the inclusion and exclusion criteria meant that we didn't include patients who had ICU-acquired weakness after leaving the ICU, who are arguably most at risk for functional decline in an acute care setting. As Batt and colleagues have noted, "skeletal muscle wasting is a key driver of ICU-acquired weakness," which in turn adversely affects physical functional outcomes.[34] Future studies should investigate the impact of bedside activity devices on post-ICU recovery in these patients.

We were unable to mask use of the device from health care providers, and it's possible this could have skewed results. Providers who entered a patient's room and saw them using the device might have changed their behavior toward these patients, for example, by offering increased encouragement for physical activity.

CONCLUSIONS

Hospitalized older adults are known to be at higher risk for deconditioning, functional declines, and decreased BADL independence after hospitalization, which in turn lead to increased risks of falls, longer hospitalizations, readmission, and even death.[14] Our study findings indicate that the use of a bedside activity device—one that allows the patient to exercise at any time without supervision and targets specific muscle groups and movements needed for BADLs—can slow or prevent functional decline and increase BADL independence. In light of health workforce

(in regular footwear, with or without walking aids), turn around, walk back, and sit down again. In this study, subjects performed the TUG test using the geriatric chair without the activity device. For older adults ages 65 to 85 years, test durations of 12 seconds or less are considered normal.[22] Longer times indicate poorer mobility[22] and, in older adults with hip osteoarthritis, have also been associated with more frequent near falls.[23] This test has demonstrated good intra- and interrater reliability.[24]

The Katz Index of Independence in Activities of Daily Living (Katz ADL) was used to evaluate each participant's ability to perform ADLs independently.[25] The Katz ADL assesses six activities: bathing, dressing, toileting, transferring, continence, and feeding.[25] For each activity, a score of either 1 (can be performed independently) or 0 (requires some degree of assistance) is given. Possible total scores range from 0 to 6, with higher scores indicating greater independence. This test has demonstrated good high internal consistency (Cronbach $\alpha = 0.83$).[26]

The TUG test and the Katz ADL were administered to each participant twice, once on admission and again on day of discharge, by a trained member of the research team (PEMF, JKL, SGES, JPS, DDR).

Data analysis. Data were analyzed using IBM SPSS version 23. Descriptive statistics were used to describe participants' sociodemographic data. Overall, an intention-to-treat analytic approach was adopted, which "ignores noncompliance, protocol deviations, withdrawal, and anything that happens after randomization," and thus better reflects real-life conditions.[27]

Mann-Whitney *U* and χ^2 tests were used to check for between-group similarities regarding sociodemographic variables, FCI scores, lengths of stay, and baseline TUG and Katz ADL scores. The normality of TUG and Katz ADL scores was investigated using the Shapiro-Wilk test. As most data were found not to be normally distributed, clustered box plots (a type of graph used to depict distribution of a variable) illustrated changes in TUG and Katz ADL scores on admission and at discharge for both groups. The Wilcoxon signed rank test was used to determine within-group pre–post changes in TUG and Katz ADL scores. The Mann Whitney *U* test was used to determine between-group differences in TUG and Katz ADL change scores (a change score is a summary measure of the average change in a variable between two time points, in this case admission and discharge). Statistical significance was set at $P < 0.05$ throughout.

RESULTS

Sample characteristics. A total of 48 participants were recruited. Of these, 23 were randomized to the intervention group and 25 to the control group. Participants ranged in age from 67 to 90 years. The majority were female (89.6%). Thirty-six participants (75%) had up to a primary school education. Most participants (87.5%) lived in public housing

Table 2. Within-Group Comparison of TUG Results on Admission and at Discharge

	TUG_A Median (IQR) in Seconds	TUG_D Median (IQR) in Seconds	Wilcoxon Signed Rank Test Statistic	*P*[a]
Intervention group	43 (34)	33 (33)[b]	0	< 0.001
Control group	43 (34)	53 (40)[c]	185	< 0.001

IQR = interquartile range; TUG_A = Timed Up and Go time on admission; TUG_D = Timed Up and Go time at discharge.

[a] Statistical significance was set at $P < 0.05$.

[b] Data missing for 4 participants.

[c] Data missing for 3 participants.

Table 3. Within-Group Comparison of Katz ADL Results on Admission and at Discharge

	Katz ADL_A Median (IQR)	Katz ADL_D Median (IQR)	Wilcoxon Signed Rank Test Statistic	*P*[a]
Intervention group	4 (1)	6 (2)[b]	78	0.002
Control group	3 (2)	4 (2)[b]	4	0.705

IQR = interquartile range; Katz ADL_A = Katz Index of Independence in Activities of Daily Living scores on admission; Katz ADL_D = Katz Index of Independence in Activities of Daily Living scores at discharge.

[a] Statistical significance was set at $P < 0.05$.

[b] Data missing for 4 participants.

apartments on a floor with a lift (elevator) landing. Most lived with family members (83.3%); and more than half (60.4%) had a caregiver who was a family member. No significant between-group differences in sociodemographic characteristics were found.

The mean FCI scores for the intervention and control groups were 1.57 and 1.4, respectively. There was no significant between-group difference in the FCI score. Regarding length of stay, the median duration for both groups was eight days. There was no significant between-group difference in length of stay. For more details on participant characteristics, see Table 1.

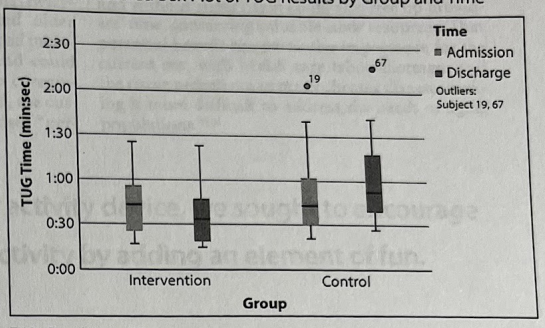
TUG times. Both groups had comparable TUG times on admission (TUG_A). The median TUG_A was 43 seconds for both the intervention and control groups. There was no significant between-group difference. In within-group comparisons of TUG times at discharge (TUG_D) with TUG_A, the intervention group demonstrated a significantly shorter TUG_D (median = 33 seconds) than TUG_A (median = 43 seconds). In contrast, the control group demonstrated a significantly longer TUG_D (median = 53 seconds) than TUG_A (median = 43 seconds). (See Table 2.) Between-group analysis showed significant change-score differences (TUG_D–TUG_A) between the intervention group (median = −7 seconds) and the control group (median = 6.5 seconds). (See Figure 2.)

Katz ADL scores. Both groups had comparable Katz ADL scores on admission (Katz ADL_A). Median Katz ADL_A for the intervention and control groups were 4 and 3, respectively. There was no significant between-group difference. In within-group comparisons of Katz ADL scores at discharge (Katz ADL_D) with Katz ADL_A, the intervention group demonstrated a significantly higher Katz ADL_D (median = 6) than Katz ADL_A (median = 4). But the control group showed no significant difference in Katz ADL_D (median = 4) compared with Katz ADL_A (median = 3). (See Table 3.) Between-group analysis showed significant change-score differences (Katz ADL_D–Katz ADL_A) between the intervention group (median = 1) and the control group (median = 0). (See Figure 3.)

DISCUSSION

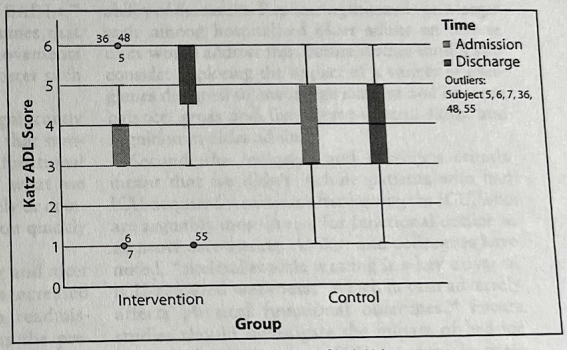
Our findings suggest that the use of a gamified bedside activity device in addition to standard care can improve hospitalized older adults' functional status and ability to perform BADLs. This was shown by the intervention group's significantly shorter TUG_D compared with TUG_A. Such change is also clinically significant; earlier research has found that reductions of as little as 0.8 to 1.4 seconds have been associated with major clinical improvements.[21] Furthermore, the intervention group had significantly higher Katz ADL_D than Katz ADL_A.

Figure 2. Clustered Box Plot of TUG Results by Group and Time



TUG = Timed Up and Go.

Figure 3. Clustered Box Plot of Katz ADL Results by Group and Time



Katz ADL = Katz Index of Independence in Activities of Daily Living.

These changes could be attributed to environmental enrichment, which has been defined as "an intervention designed to facilitate physical (motor and sensory), cognitive, and social activity by the provision of equipment . . . [in] a structured, stimulating environment."[28] Having a bedside activity device on the unit gave patients the option to exercise whenever they wished, and the built-in safety features allowed them to do so independently, without requiring the presence of a physiotherapist. The enriched hospital environment made it possible for patients to exercise using movements essential to independent daily living in a community setting.

In gamifying the bedside activity device, we sought to encourage increased physical activity by adding an element of fun, thus preventing or reducing deconditioning and potential loss of independence in performing BADLs. Indeed, from admission to discharge, the intervention group

shortages and the "graying" of the population worldwide, it's imperative that such innovative technologies continue to be developed and implemented in health care settings. In so doing, we can transform the future of health care. ▼

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