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A Simple Reminder that Increases Levels of Physical Activity and Improves Glycemic Control in Patients with Type 2 Diabetes

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What is already known on this topic?

- *Increasing physical activity is a well-established component in the management of diabetes.*
- *In general, interventions to promote physical activity include giving patients additional portable devices or controlled use of smartphone apps.*
- *In many cases, additional healthcare personnel are required to provide guidance or follow-up with patients.*

What this study adds on this topic?

- *Patients were given a very short (8-second) reminder during routine diabetes outpatient visits.*
- *This reminder encouraged patients to regularly check their step count data on their smartphones or smartwatches, and as a result, most patients significantly increased their daily step count within 6 months.*
- *The intervention was practical, low cost, and time-efficient, making it suitable for busy clinical settings.*

Abstract

Objective: Daily step count is widely accepted as a valuable indicator of physical activity level. The study aimed to test whether it was possible to establish and/or increase patients' connectedness with the pedometer data in their smartphones and smartwatches through a short reminder.

Methods: The study included 70 patients whose daily average step count was checked, who provided good glycemic control and whose treatment would not be changed (HbA1c < 7.5%). Demographic and laboratory data of the patients, average step counts in the last 6 months, and smartphone models were recorded, and these data were compared with the data after 6 months.

Results: The study included 70 diabetic patients, 30 women and 40 men. The mean number of steps increased from 5587.8 ± 2959 at baseline to 6219 ± 3001 after 6 months. The number of steps increased from 4692 ± 2402 to 6502 ± 2813 in 47 (62%) patients with brief reminder ($P < .001$). There is a correlation between the increase in the number of steps and the decrease in HbA1c ($P < .05$).

Conclusion: This study demonstrates that a short reminder recited by physicians during the diabetes outpatient clinics visits aimed at increasing connectedness to smartphone/watch daily step count data leads to an increase in daily step count in most of the patients over 6 months. The increase in the daily step count correlated significantly with a decrease in HbA1c levels.

Keywords: Daily step count, diabetes, physical activity reminder

Introduction

Despite recent advances in the pharmacological treatment of diabetes, lifestyle change remains the mainstay of treatment at all stages of the disease.[1,2] The impact of a healthy lifestyle on glycemic control and prevention of complications is profound and well documented.[3] Exercise and physical activity are principal components of a healthy lifestyle.[4]

Although exercise prescribing during clinic visits is widely recommended, this is only practiced in a few centers, mostly due to time constraints and lack of knowledge and awareness of healthcare providers.[5] There are also patient-related barriers, and only a minority of patients with diabetes are able to integrate exercise into their daily routine permanently.[6]

Increasing physical activity itself improves blood glucose control in patients with diabetes, even in those who do not practice structured exercise programs.[7] Daily step count is widely recognized as a valuable indicator of physical activity levels.[6] Self-monitoring of daily steps can help to increase physical activity levels, similar to how self-monitoring of blood glucose improves glycemic control.[8]

Advancing technology has profound effects on the lifestyle which act as a double-edged sword as far as leading a healthy life is concerned. It eases and imposes sedentary behavior, thereby

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contributing to the pathogenesis obesity and type 2 diabetes.[9] On the other hand, technology offers opportunities to enjoy, monitor, and increase physical activity.[10]

The use of smartphones is one of the most important ways by which technology influences human life. Ninety percent of the world population uses smartphones,[11] and the average screen time spent on smartphones is enormous, amounting to 4-6 hours per day.[12] Almost all smartphone brands have built-in health applications, some of which are quite sophisticated and complicated. These applications can be used effectively as part of lifestyle change programs.[13] However, they usually require highly motivated patients and healthcare providers as well as sufficient time and knowledge.

Smartphones and many smartwatches have an integrated pedometer that provides information about the wearer's daily step count.[14,15] The simplicity and ease with which daily step count data can be captured could help track and increase physical activity, especially in ambulatory care settings where time and human resources are limited.

In most parts of the world, the contact time between the physician and the patient is very short, being only 5 minutes in Türkiye, for example.[16] Therefore, efficient healthcare practices should be time-saving at the same time.

The present study was performed in a busy diabetes outpatient clinic where previously exercise and physical activity recommendations had been inconsistent or even skipped most of the time.

The study aimed to test whether a short verbal reminder could establish and/or increase patients' connectedness with pedometer data in their smartphones and smartwatches, and whether this reminder would result in increased physical activity levels and improved glycemic control over 6 months.

Methods

The study was conducted in accordance with the Declaration of Helsinki and Good Clinical Practice guidelines. Written informed consent was obtained from all patients participating in the study. All study procedures were performed in accordance with the ethical standards of the Declaration of Helsinki and approved by ethics committee of İstanbul University-Cerrahpaşa, Cerrahpaşa Faculty of Medicine (Approval no: E-83045809-604.01-937729, Date: 08.03.2024)

Patients with type 2 diabetes admitted to the diabetes outpatient clinic between December 2022 and January 2024 were screened. Those possessing a smartphone or smartwatch with HbA1c levels below 7.5% were included in the study. The study excluded patients with stage 4-5 chronic kidney disease, liver failure, patients with hematologic malignancies who received chemotherapy, pregnant or breastfeeding women, and patients with movement limitations. The patients' demographic data (age, gender), duration of diabetes, HbA1c value, medications (oral antidiabetic agents and insulin) were recorded. The average daily step counts of the previous 6 months were recorded at the first visit to compare with the readings of next 6 months following the intervention. No specific dietary intervention or structured nutritional program was applied during the study period. All participants continued their usual dietary routines.

The intervention was to say "Telefonunuz veya akıllı saatinizdeki günlük adım sayısını düzenli olarak kontrol ediyor musunuz? Etmiyorsanız lütfen edin" (Do you regularly check your daily step count on your phone or smartwatch? If not, please do so) to the patients during the visit. Reciting this phrase took 8 seconds on average. No changes were made to their medical treatment, either by adding on a new drug or increasing the doses of previously taken medications. The selection of well-controlled patients (HbA1c < 7.5%) was to justify keeping the medical treatment unchanged to be able to test the effect of the intervention exclusively. Patients were called back 6 months later for the next visit. The average daily step counts of the previous 6 months were recorded at the first visit to compare with the readings of next 6 months following the intervention.

Of the 82 patients initially included, 12 patients were later excluded for the following reasons: 6 patients changed their devices during the procedure, 2 patients immobilized for more than 4 weeks due to orthopedic surgery, and 4 did not come to the final visit. The data collected from the remaining 70 patients were analyzed.

At the second visit, the average daily step count and HbA1c values were recorded to compare with the values obtained at the first visit. Those who had an increased average daily step count are referred to as the "responder group," the others as the "non-responder group."

Statistical Analysis

The software Statistical Package for the Social Sciences (SPSS Inc.; Chicago, IL, USA) version 22.0 was used for all statistical analyses. In the post-hoc power analysis, the power was calculated as 94.7% with a 95% CI and an effect size of 0.4 for the 2 groups comparison. The distribution of continuous variables was assessed using the Shapiro–Wilk test to determine normality. For variables with a normal distribution, paired samples t-test was applied to compare parameters between visits, and Pearson correlation coefficient was used for correlation analysis. Statistical significance was accepted at $P < .05$, with a CI of 95%.

Results

In this study, 70 patients with type 2 diabetes (30 female and 40 male) were examined. The mean age was 57.9 ± 12.5 years and the median duration of diabetes was 12.85 ± 8.15 years (Table 1).

Six months later, 47 (67%) patients increased their average daily step count in response to the intervention (22 female and 25 male). In 23 patients, the average daily step count did not increase (8 female and 15 male). The responders and nonresponders were similar in terms of age and duration of diabetes (Table 2).

In the responder group, the mean daily step count increased from 4692 ± 2402 to 6502 ± 2813 ($P < .001$) (Table 2). Although the overall decrease in HbA1c levels was not significant in the responder group at 6 months (6.64 vs. 6.63 P: .653), it was

Table 1. Demographic Data of the Patients in the Study

Age (Years), Mean ± SD	**57.9 ± 12.5**
Sex, n (%)/age (years), mean ± SD	
Female	30 (42.8)/58.9 ± 11
Male	40 (57.2)/57.1 ± 12.1
Duration of diabetes (years), mean ± SD	12.85 ± 8.15
Number of insulin treated (n)	23
Number of OAD treated (n)	61
Number of patients using smartwatch, n (%)	4 (5)
Number of patients using smartphone, n (%)	66 (95)

OAD, oral antidiabetic drug; SD, standard deviation.

Table 2. 6-Month Daily Step Count and HbA1c (%) Change

	First Visit Measurements	Second Visit Measurment	*P*
Patients (n)	82	70	
HbA1c (%), mean ± SD	6.64 ± 0.61	6.74 ± 0.76	.653
Hba1c value of patients with increasing daily step count (%), mean ± SD	6.64 ± 0.64	6.63 ± 0.71	.653
Hba1c value of patients with decreasing daily step count (%), mean ± SD	6.65 ± 0.56	6.96 ± 0.81	.121
Daily step count, mean ± SD	5587.8 ± 2959	6219.2 ± 3001	**.01**
Patient with increased daily step count, mean ± SD	4692 ± 2402	6502 ± 2813	**<.001**

HbA1c, glycated hemoglobin A1c; SD, standard deviation.

inversely correlated with the change in average daily step count ($r = -0.244$, $P < .05$).

In the non-responder group, HbA1c increased from 6.65 to 6.96 *P*: .121(Table 2).

Discussion

This study shows that a short reminder, recited by physicians during the diabetes outpatient clinics visits and aimed at increasing connectedness to smartphone/watch daily step count data, leads to an increase in daily step count in most of the patients (responder group) in 6 months. The increase in the daily step count correlated significantly with a decrease in HbA1c levels.

Smartphone data augmented lifestyle change programs were previously shown to increase physical activity in different settings and patient groups. In the Health Steps™ Lifestyle Prescription Program that aimed at increasing physical activity in patients with a variety of chronic diseases, patients were interviewed face-to-face every 2 months along with downloading and using a specific smartphone application. At the end of 6 months, patients' physical activity levels increased significantly.[17] In contrast, the study focused only on patients with type 2 diabetes and did not include any follow-up beyond a routine outpatient visit. This highlights the ease of introducing minimal referrals into standard care without increasing clinical workload. The SMART MOVE Study showed that downloading an application on Android smartphones followed by detailed instructions about how to use it resulted in an increase of approximately 1000 steps/day in 8 weeks.[18] However, the study population did not include patients with diabetes. The study observed a similar increase in step counts without patients needing to install any apps or receive additional instructions, suggesting that physical activity can be significantly influenced by a short, verbal reminder.

A meta-analysis from 2019 showed that a wide variety of smartphone applications can increase physical activity in diverse groups of people although the effectiveness did not differ on the basis of target population.[19]

Another meta-analysis that included 11 randomized controlled trials showed that pedometer use was associated with an increased daily step count in patients with diabetes. However, this increase did not improve glycemic control.[20] The authors speculated that the lack of effect of increased physical activity on glycemic control could have been due to changes in the diet and drug doses. In this study, HbA1c levels decreased in the majority of patients in the responder group, despite the absence of any changes in medical treatment or dietary counseling. This reduction was correlated with the increase in daily step count, supporting the notion that even modest improvements in physical activity may contribute to better glycemic control in patients with type 2 diabetes.

In a study comparing aerobic exercise, physical activity as taking at least 10000 steps per day, and a sedentary lifestyle in patients with diabetes, it was shown that both aerobic exercise and physical activity resulted in improved glycemic control over a sedentary lifestyle. The physical activity group was even superior to the aerobic exercise group. Active interventions in this study included exercise prescriptions, weekly goal setting, additional pedometer use, and aerobic exercise instructions by nurses.[21] In contrast to such structured and resource-intensive interventions, the study achieved comparable outcomes through a brief verbal reminder, highlighting the potential of low-cost and highly scalable approaches in routine clinical practice.

A recent study from Japan showed that monitoring of daily step count using a pedometer, which was associated with a self-management support system that allowed patients to monitor step count, resulted in an improvement in glycemic control in 3 months.[22] However, changes to the drug treatment, which could affect glycemic control, were not stated in this article.

Unlike previous studies that implemented new devices, applications, support systems, etc., this study prioritized practicality, ease of implementation, and simplicity. The approach was to use already collected data by the patients' devices and increase their awareness and connectivity with it. This simple practice carried out in almost no time worked for increasing physical activity and improving glycemic control in most patients. Repeating reminders during subsequent visits, delivering the reminder by health care personnel other than the physicians, and visual versions of the reminders like posters on the walls of waiting rooms may also result in favorable results. The reminder may also be more effective in patients with less well-controlled conditions than those were included in this study.

This study has several limitations. First, the lack of a control group and the relatively small sample size may be limiting, and another limitation is the lack of data on how long participants carried their cell phones each day, which has the potential to affect the accuracy of activity measures.

Data Availability Statement: The data is with the corresponding author and will be made available at a reasonable request.

Ethics Committee Approval: Ethical committee approval was received from the Ethics Committee of İstanbul University-Cerrahpaşa, Cerrahpaşa Faculty of Medicine (Approval no: E-83045809-604.01-937729, Date: 08.03.2024)

Informed Consent: Written informed consent was obtained from the patients who agreed to take part in the study.

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