Does sodium and potassium intake assessment by diet-related mobile applications do more harm than good?

Piotr Sobieraj[1], Agnieszka Bzikowska-Jura[2], Filip Raciborski[3], Alicja Kucharska[4], Dorota Szostak-Węgierek[5], Thomas Kahan[6]

[1]Department of Internal Medicine, Hypertension and Vascular Diseases, Medical University of Warsaw, Warszawa, Poland
[2]Department of Medical Biology, Faculty of Health Sciences, Medical University of Warsaw, Warszawa, Poland
[3]Department of Prevention of Environmental Hazards, Allergology and Immunology, Medical University of Warsaw, Warszawa, Poland
[4]Department of Human Nutrition, Faculty of Health Sciences, Medical University of Warsaw, Warszawa, Poland
[5]Department of Clinical Dietetics, Faculty of Health Sciences, Medical University of Warsaw, Warszawa, Poland
[6]Department of Clinical Sciences, Division of Cardiovascular Medicine, Danderyd Hospital, Karolinska Institute, Stockholm, Sweden

Correspondence to:
Piotr Sobieraj, MD, PhD, Department of Internal Medicine, Hypertension and Vascular Diseases, Medical University of Warsaw, Banacha 1A, 02–097 Warszawa, Poland, phone: +48 22 599 28 28, e-mail: piotr.sobieraj@wum.edu.pl

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INTRODUCTION

Increased sodium intake is associated with elevated blood pressure (BP) and a higher risk of cardiovascular events while increased potassium intake appears to have opposite effects [1, 2].

Recent recommendations for cardiovascular prevention point to the need for reduced sodium intake and underline the positive role of potassium intake (e.g., with fruits or vegetables) [3].

About three-quarters of sodium are consumed with processed foods [4]. The estimation of the amount of sodium consumed with processed foods may be tedious. Thus, non-pharmacological intervention in the treatment of a particular patient remains difficult to assess, and a tool supporting low-sodium diet and education should be available.

It can be expected that patients will use the available mobile applications to monitor sodium intake [5]. Promising experience with only very few applications verified in clinical trials may lead both care providers and patients to an illusion about the benefits of using any of the available applications [6, 7]. Unfortunately, most of the available mobile applications have not been tested appropriately for medical purposes [8].

Thus, we aimed to validate four of the popular diet-related mobile applications for the assessment of sodium and potassium intake in processed food products.

METHODS

Among popular health-related mobile applications available in the Polish Appstore (*www.apple.com/pl/app-store/*), 4 mobile applications (App1=FatSecret 9.8, Secret Industries Pty Ltd, Caulfield North, Australia; App2=Yazio, Yazio 7.4.2. GmbH, Erfurt, Germany; App3==Fitatu 3.11.0, Fitatu Sp. z o.o., Poznań, Poland; App4=MyFitnessPal 21.22.5.36915, MyFitnessPal Inc., San Francisco, CA, US) were selected for the study.

A dietician performed a nutritional assessment of randomly selected two-day dietary recalls of 120 participants from the trial: "National Study of Nutrition and Nutritional Status of the Adult Polish Population in the Years 2017–2020" using the Polish reference method (RM), Dieta 6.0 software [9]. Sodium and potassium intake measured by selected mobile applications was compared with RM.

All quantitative values are presented using median values and interquartile range (IQR) or numbers followed by percentages. The comparisons of quantitative variables were performed using the Wilcoxon signed-rank test. Spearman's coefficients and scatterplots were used to present correlations between RM and results obtained by mobile applications. The agreement between methods was assessed using the Bland-Altman method. Detailed descriptions of mobile applications, dietary recalls selection, assessment, and statistical methods are available as Supplementary material.

Table 1. The comparison of daily median intake of sodium and potassium and the agreement between values obtained by the investigated mobile applications and the reference method (Bland-Altman analysis)

	Mobile application	Intake, mg	*P*-value	Bias, mg	Upper limit of agreement, mg	Lower limit of agreement, mg
Sodium	Reference method	3846 (2942–5235)	—	—	—	—
	App1	3520 (2439–4530)	<0.001	483 (278–687)	2697 (2347–3046)	–1731 (–2081–[–1382])
	App2	1745 (973–2642)	<0.001	2083 (1808–2357)	5060 (4589–5530)	–894 (–1365–[–424])
	App3	1942 (1234–2792)	<0.001	2010 (1765–2255)	4671 (4250–5091)	–651 (–1071–[–230])
	App4	247 (14–1112)	<0.001	3427 (3099–3755)	6981 (6419–7543)	–128 (–689–434)
Potassium	Reference method	3188 (2348–3914)	—	—	—	—
	App1	2910 (2062–3574)	<0.001	236 (84–387)	1880 (1620–2140)	–1409 (–1668–[–1149])
	App2	1244 (766–1784)	<0.001	1907 (1658–2157)	4615 (4187–5043)	-800 (–1228–[–372])
	App3	1985 (1128–2652)	<0.001	1256 (1038–1474)	3616 (3243–3989)	–1104 (–1477–[–731])
	App4	286 (11–684)	<0.001	2748 (2498–2999)	5467 (5037–5897)	29 (–400–459)

Sodium and potassium intake measured by reference method and each mobile application is presented as median values and interquartile range. Comparisons of values obtained by each mobile application with the reference method were made using the paired Wilcoxon signed-rank test with Bonferroni correction for multiple comparisons. Biases and limits of agreement with 95% confidence intervals for 120 subjects in each group

Abbreviations: App1, FatSecret; App2, Yazio; App3, Fitatu, App4; MyFitnessPal

RESULTS AND DISCUSSION

Clinical characteristic of the study group

Investigated dietary recalls were obtained from 60 females and 60 males. Median age and body mass indexes were 41 (28.8–54.0) years and 24.7 (22.4–27.7) kg/m^2, respectively. Considering dietary assessment, daily median energy intake was 2193 (1504–2767) kcal, protein intake 80 (55–100) g, carbohydrates intake 281 (198–339) g, and fat intake 76 (55–117) g.

Sodium intake measurements

According to the RM, daily median sodium consumption was 3846 (2942–5235) mg. Sodium consumption measured by mobile application was lower than measured by RM (Table 1). App4 showed no consumption of sodium (sodium intake = 0 mg) in 15 (12.5%) of the dietary records.

Sodium intake measured with App1 was strongly related to the RM, whereas App2 and App3 revealed moderate and App4 no correlation. Correlations are presented in Supplementary material.

The results of Bland-Altman analyses revealed relevant bias. The lowest bias was observed for App1, while App2 and App3 had similar intermediate biases, and the largest bias was observed for App4 (Table 1). Similarly, the lowest range between upper and lower limits of agreement was observed when App1 was used. Bland-Altman plots are available in Supplementary material.

Potassium intake measurements

Median potassium intake measured with RM was 3188 (2348–3914) mg. Potassium intake estimated with the mobile applications was lower than for RM (Table 1). App4 showed no consumption of potassium (potassium intake = 0) in 27 (22.5%) of the analyzed dietary records.

Potassium intake assessed by App1 and RM was strongly related, whereas the relations with App3 and App4 were moderate and with App4 weak. Correlations are presented in Supplementary material.

The results of Bland-Altman analyses showed relevant bias. The lowest bias was observed for App1, while App2 and App3 had similar moderate biases, and the largest bias was observed for App4 (Table 1). The range between lower and upper limits of agreement was lowest when App1 was used. Bland-Altman plots are available in Supplementary material.

We assessed daily sodium and potassium intake measured by mobile applications in comparison to the reference method in two-day dietary recalls from randomly selected 120 Polish citizens. Our results reveal that the four popular diet-related mobile applications do not agree with the RM. All applications underestimated sodium intake in most participants. This may give the users the false impression that their potentially excessive salt intake is normal. Also, potassium intake was underestimated in most of the participants. Among the products evaluated, the poorest results for both sodium and potassium intake were observed with MyFitnessPal (App4), where also a remarkable zero daily consumption of sodium and potassium was reported in >10 and >20%, respectively, of the participants, while FatSecret (App1) showed the least deviation from the RM.

Only a few small studies regarding the validity of popular mobile applications for the assessment of sodium intake have been published. Both FatSecret (App1) and MyFitnessPal (App4), among other mobile applica-

tions, against the United Kingdom reference method (Dietplan6) were unreliable in the assessment of sodium intake [10]. In a Belgian study, MyFitnessPal (App4) had a poor agreement with the reference method (Nubel) [11]. Moreover, the data from MyFitnessPal required cleaning before the analysis due to extremely high and likely erroneous values.

Despite poor results of validation studies, MyFitnessPal has been used in clinical trials aimed to decrease sodium intake; while sodium intake was reduced there was no significant BP reduction [12, 13]. FatSecret, Fitatu, or Yazio, have not been used in intervention studies aimed to reduce salt intake.

The mobile application Keenoa using an artificial intelligence algorithm underestimated potassium (and sodium as well) intake based on food images (photography) [14].

Important limitations of the study must be considered. First, mobile applications are continuously developing, and our results may become outdated. Second, the study was performed in the Polish population and may not be valid in other populations. Third, the study lacked assessment of urinary sodium and potassium excretions [15].

In conclusion, mobile applications may be easily accessible (depending, of course, on an individual's ability to use them); they are cheap and helpful tools. However, they must be properly validated before they are implemented for use. Currently, we cannot recommend any mobile applications for the assessment of sodium or potassium intake.

Supplementary material

Supplementary material is available at https://journals.viamedica.pl/kardiologia_polska.

Article information

Conflict of interest: None declared.

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