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ORIGINAL ARTICLE

The association between breakfast consumption patterns and physical fitness

Association entre les habitudes de consommation du petit déjeuner et les variables de condition physique dans un échantillon d'adultes et de personnes âgées en Corée

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Adults;
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Summary

Aim. — The purpose of this study was to examine the association between breakfast consumption patterns and physical fitness variables based on a nationwide study in Korea focused on non-elderly and elderly adults.

Methods. — A total of 2798 adults (men = 1662, women = 1136; aged 20–64 years) and 625 elderly people (men = 263, women = 362; aged over 65 years) participated in The Survey of National Physical Fitness in 2015, conducted by the Korea Institute of Sport Science and Korea Ministry of Culture, Sports and Tourism. The breakfast consumption pattern was collected via the self-report survey. Physical fitness variables in the adult group (grip strength, sit-ups, standing long jump, 50 m dash, sit-and-reach, and 20 m shuttle-run) and the elderly group (grip strength, sit-ups, sit-to-stand, sit-and-reach, back scratch, one-leg standing with eyes open, and six-minute walk) were directly measured. The association between breakfast consumption patterns and physical fitness variables were then evaluated by conducting one-way analysis of variance and post-hoc testing of Tukey.

Results and conclusion. — Adult men showed significant differences in sit-ups ($P=0.043$), standing long jump ($P=0.005$), 50 m dash ($P=0.008$), and sit-and-reach ($P=0.047$) among the four breakfast pattern groups. Adult women showed significant differences in sit-ups ($P=0.018$), standing long jump ($P=0.007$), and 50 m dash ($P=0.044$). However, both elderly men and women

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showed no significant differences in all physical fitness variables ($P > 0.05$). In Korean adults, the physical fitness variables, sit-ups (muscular endurance), standing long jump (power), and 50 m dash (speed), could be differentiated based on breakfast consumption patterns. However, in the elderly population, physical fitness variables showed no significant differences based on breakfast consumption patterns.

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Résumé

Objectifs. — Le but de cette étude était d'examiner l'association entre les habitudes de consommation du petit-déjeuner et les variables de condition physique à partir d'une étude nationale menée en Corée et axée sur les adultes d'âge moyen et les personnes âgées.

Méthodes. — Au total, 2798 adultes (hommes = 1662, femmes = 1136; âgés de 20 à 64 ans) et 625 personnes âgées (hommes = 263, femmes = 362 ; âgés de plus de 65 ans) ont participé à l'Enquête sur la condition physique nationale en 2015, réalisée par l'Institut coréen des sciences du sport et Ministère coréen de la culture, des sports et du tourisme. Les habitudes de consommation du petit-déjeuner ont été recueillies via l'enquête d'auto-évaluation. Les variables de condition physique dans le groupe d'adultes (force de préhension, redressement assis, saut en longueur debout, 50 m dash test, sit-and-reach test, et course navette de 20 m) et chez les personnes âgées (force de préhension, redressement assis, passage en orthostatisme, passage en position assise, grattage du dos en appui monopodal les yeux ouverts et test de marche de six minutes) ont été mesurés directement. L'association entre les habitudes de consommation du petit déjeuner et les variables de condition physique a ensuite été évaluée en effectuant une analyse de variance à un facteur et des tests post-hoc de Tukey.

Résultats et conclusion. — Les hommes adultes présentaient des différences significatives en sit-ups ($p = 0,043$), en saut en longueur debout ($p = 0,005$), au 50 m dash test ($p = 0,008$) et en position assise ($p = 0,047$) entre les quatre groupes. Les femmes adultes ont montré des différences significatives pour le redressement assis ($p = 0,018$), le saut en longueur debout ($p = 0,007$) et le 50 m dash test ($p = 0,044$). Cependant, les hommes et les femmes âgés ne montrent aucune différence significative dans toutes les variables de condition physique ($p > 0,05$). Chez les adultes coréens, les variables de condition physique, sit-ups (endurance musculaire), saut en hauteur debout (puissance) et 50 m dash test (vitesse) semblent présenter des différences en fonction des habitudes de consommation du petit-déjeuner. Cependant, chez les sujets plus âgés, les variables de condition physique ne montraient aucune différence significative en fonction des habitudes de consommation du petit-déjeuner.

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1. Introduction

For diet control or to prevent obesity, skipping breakfast might be helpful. However, previous studies show that though skipping breakfast reduces intake of energy during the morning, it is strongly related to a higher prevalence of obesity based on meta-analysis and large cohort studies [1–4]. Moreover, longitudinal cohort studies also indicate that skipping breakfast is associated with weight change [5]. Interestingly, recent studies in Europe indicate that skipping breakfast is also associated with physical fitness variables [6,7]; this is very important because physical fitness variables are also associated with obesity and cardiometabolic risk factors [8,9].

In the field of sports science, physical fitness comprises motor-related physical fitness and health-related physical fitness. Motor-related physical fitness variables consist of power, balance, and agility. Health-related physical fitness

variables consist of muscular strength, muscular endurance, cardiorespiratory endurance, and flexibility [10]. Nevertheless, there are two limitations in previous studies: first, when previous studies reported on physical fitness, they only focused on cardiorespiratory endurance ($VO_2\max$). While that is the gold standard for assessing physical fitness, supplementary research on other physical fitness variables, such as motor-related and health-related physical fitness variables, is needed to establish sport science principles. Second, as far as we know, the relationship between skipping breakfast and physical fitness variables has been studied only in Europe and has not been reported in other countries, such as Asia, including the Republic of Korea. Moreover, in Korea, there has been no nationwide study focused on the association between breakfast consumption patterns and physical fitness variables. For these reasons, we aimed to examine the association between breakfast consumption patterns and physical fitness variables based on a nationwide study

Table 1 Physical characteristics of the participants.

Variables	Adults (n = 2798)		Elderly (n = 625)	
	Men (n = 1662)	Women (n = 1136)	Men (n = 263)	Women (n = 362)
Age (years)	38.14 ± 12.71	39.44 ± 13.08	72.22 ± 5.25	73.57 ± 5.84
Height (cm)	173.12 ± 6.08	160.00 ± 5.69	165.79 ± 5.53	153.86 ± 5.50
Weight (kg)	73.20 ± 9.73	56.99 ± 7.69	66.39 ± 7.99	56.67 ± 7.21
Body mass index (kg/m ²)	24.41 ± 2.86	22.29 ± 2.95	24.13 ± 2.43	23.94 ± 2.85
Physical fitness				
Grip strength (kg)	42.78 ± 9.11	25.04 ± 5.96		
Sit-ups (reps/60 sec)	34.76 ± 11.96	20.99 ± 12.38		
Standing long jump (cm)	197.72 ± 31.63	139.90 ± 26.29		
The 50m dash (sec)	8.89 ± 1.70	11.32 ± 1.97		
Sit-and-reach (cm)	9.35 ± 8.41	14.73 ± 8.27		
The 20-m shuttle-run (sec)	32.89 ± 17.21	18.18 ± 8.27		
Grip strength (kg)			32.14 ± 7.71	20.54 ± 5.37
Sit-ups (reps/60 sec)			13.21 ± 9.90	5.33 ± 7.46
Sit-to-stand (reps/30 sec)			19.29 ± 7.76	16.26 ± 6.40
Sit-and-reach (cm)			4.31 ± 9.02	10.62 ± 8.60
Back scratch (cm)			−9.49 ± 12.34	−3.87 ± 10.10
One-leg standing test with eyes open (sec)			33.34 ± 35.21	22.32 ± 25.98
Six-minute walk (m)			552.94 ± 123.81	486.87 ± 134.95
Breakfast eating patterns				
Skipping breakfast everyday	277 (16.7)	152 (13.4)	6 (2.3)	9 (2.5)
Irregular breakfast with snack	72 (4.3)	76 (6.7)	14 (5.3)	15 (4.1)
Irregular breakfast meal	538 (32.4)	364 (32.0)	36 (13.7)	62 (17.1)
Breakfast meal everyday	775 (46.6)	544 (47.9)	207 (78.7)	276 (76.3)

Results are expressed as mean ± standard deviation or n (%).

in Korea, focusing on both adults and the elderly population.

2. Methods

2.1. Participants

The Survey of National Physical Fitness in 2015 was a cross-sectional epidemiologic study with a sampling design within 14 clustering and stratifications, such that the samples covered the Republic of Korea. The survey was conducted by the Korea Institute of Sport Science and Korea Ministry of Culture, Sports and Tourism. A total of 2,798 Korean adults (men = 1662, women = 1136; aged 20–64 years) and 625 Korean elderly people (men = 263, women = 362; aged over 65 years) participated in this study. The social security number, name, home address, and telephone number were not surveyed; therefore, institutional review board ethical approval was not required. Furthermore, all research procedures were controlled and approved by the Korea Institute of Sport Science and Korea Ministry of Culture, Sports and Tourism. The physical characteristics of the participants are shown in [Table 1](#).

2.2. Breakfast consumption patterns

Breakfast consumption patterns were classified based on one question: “What is your breakfast consumption pattern in a week?” The possible responses were:

- skipping breakfast everyday (worst condition);
- irregular breakfast with snack;
- irregular breakfast meal;
- breakfast meal everyday (best condition).

2.3. Measurement of physical fitness variables in the adult group

2.3.1. Grip strength (muscular strength)

the participants had to grasp the dynamometer by placing it on the distal interphalangeal joint, using the adjusting screw until it was fitted. Subjects were told to pull the dynamometer as strongly as possible by extending the arm straight and maintaining a 5° angle between the trunk and the arm. The results were recorded by conducting the exercise twice using the dominant hand.

2.3.2. Sit-ups (muscular endurance)

The participants had to lie down on a mat with legs approximately 30 cm apart and bending the knee perpendicularly, then locking the fingers behind the head. The assistant held the ankles of the subject with two hands, called out “start”, and counted the number of times that the subject raised the body to touch both knees with both elbows and returned to a lying position. One repetition was counted only when both elbows touch both knees. The number of repetitions done in one minute were recorded.

2.3.3. Standing long jump (power)

The participants were instructed to jump as far as they could, and the distance between the start line and the heel was measured from two trials.

2.3.4. The 50 m dash (speed)

The time taken to complete the 50 m dash was recorded.

2.3.5. Sit-and-reach (flexibility)

The participants were instructed to sit on the mat after taking off their shoes, extend the knees, and completely fix the sole on the perpendicular plane of the measuring apparatus, not widening the stance > 5 cm between the feet with legs extended straight. The participant had to stretch out both hands to touch the measuring scale when ready and the scale is measured.

2.3.6. The 20-m shuttle-run (cardiovascular endurance)

Participants had to shuttle, without resting and until exhaustion, between two lines that were 20 m wide; the time required to perform this was recorded.

2.4. Measurement of physical fitness variables in the elderly group

2.4.1. Method of measurement of grip strength

The method of measurement of grip strength (muscular strength), sit-ups (muscular endurance), and sit-and-reach (flexibility) was the same as that in the adult group.

2.4.2. Sit-to-stand (muscular endurance)

The participant had to place his/her arms on the chest to form an X shape, straighten the waist, and sit in the middle of the chair with the soles fixed completely on the ground. The subject moved from the standing position to the sitting position when he/she hears "start". The number of complete repetitions made in 30 seconds was counted.

2.4.3. Back scratch (flexibility)

One hand of the participant is placed on the back of the shoulder and allowed to go down lower to the middle of the back with the elbow pointing upwards. The participant is then instructed to let the other hand touch or grab the hand with a palm-up position. The subject was not allowed to move the upper hand or correct the hands to place the middle finger in the right position. The participant was allowed to practice twice and record the best value after two measurements.

2.4.4. One-leg standing test with eyes open (balance)

When the "start" signal was given, the participant had to raise one leg and arm parallel to the ground. The test is stopped if the leg falls on the ground. The participant could practice once and record the best score after two measurements.

2.4.5. Six-minute walk (cardiovascular endurance)

The participant had to stand at the start line, and start when the "start" signal was given, they were to walk as long and as fast as possible within 6 minutes. The participants

were alerted regarding the time remaining so that they can control their pace. They were stopped once the 6 minutes had lapsed and were asked to move to the marked point, which is 5 m away. Participants were told to walk slowly for a few minutes after remaining stationary to cool down their bodies. The exercise was measured in distance.

The safety of all the participants in all fitness tests was ensured by following the book "Advanced Fitness Assessment and Exercise Prescription" and guidelines from "The Senior Fitness Test Manual" [10,11].

2.5. Statistical analysis

All the results from this study are shown as mean $\pm$ standard deviation or number (%). One-way analysis of variance (ANOVA) was used to verify the inter-group differences in physical fitness variables based on the four breakfast consumption pattern groups. Tukey (post-hoc testing) was conducted to specifically confirm which groups showed differences when a difference between the groups occurred. The analyses were performed using SPSS version 18.0 (IBM Corp., Armonk, NY, USA) and statistical significance was set at $P < 0.05$.

3. Results

As seen in Table 2, adult men showed significant differences in sit-up ($P = 0.043$), standing long jump ($P = 0.005$), 50 m dash ($P = 0.008$), and sit-and-reach ($P = 0.047$) by one-way ANOVA as stratified by breakfast consumption patterns. The Tukey post-hoc test showed that the group that ate breakfast everyday had superior 50 m dash and sit-and-reach compared to the group that skipped breakfast everyday ($P < 0.05$). Adult women showed significant differences in sit-ups ($P = 0.018$), standing long jump ($P = 0.007$), and 50 m dash ($P = 0.044$) via one-way ANOVA based on breakfast consumption patterns. The Tukey post-hoc test showed that the group that ate breakfast everyday had fewer sit-ups, shorter standing long jump, but a higher 50 m dash compared to the group that skipped breakfast everyday ($P < 0.05$). As shown in Table 3, elderly men and women both showed no significant differences in all physical fitness variables ($P > 0.05$) by one-way ANOVA stratified by breakfast consumption pattern.

4. Discussion

This study examined the association between breakfast consumption patterns and physical fitness variables in a sample adult and elderly population in Korea. Overall, our results indicate that both adult men and women in the group that ate breakfast everyday had worse physical fitness level, especially the in the 50 m dash (speed) in men and sit-ups (muscular endurance), standing long jump (power), and 50 m dash (speed) in women compared to the group that skipped breakfast everyday.

Traditionally, skipping breakfast is significantly associated with obesity [12,13]. In addition, it is associated with a larger waist circumference, more cardiometabolic risk factors, poorer diet quality, and more unhealthy lifestyle behaviors [14]. According to Brun et al. (1995),

Table 2 The differences in physical fitness variables based on breakfast consumption patterns in adult participants (aged 20 to 64).

	Group 1	Group 2	Group 3	Group 4	Overall F	Overall P
Men	(n = 277)	(n = 72)	(n = 538)	(n = 775)		
Grip strength (kg)	43.90 ± 9.64	43.36 ± 8.20	42.61 ± 8.88	42.44 ± 9.13	1.920	0.124 N/S
Sit-ups (reps/60 sec)	35.77 ± 11.95	36.29 ± 10.25 N/S	35.28 ± 11.29 N/S	33.90 ± 12.50 N/S	2.725	0.043*
Standing long jump (cm)	200.28 ± 32.42	193.81 ± 29.77 N/S	200.64 ± 31.12 N/S	195.15 ± 31.65 N/S	4.230	0.005**
The 50 m dash (sec)	8.71 ± 1.43	8.68 ± 1.45 N/S	8.80 ± 1.56 N/S	9.04 ± 1.88***	3.922	0.008**
Sit-and-reach (cm)	8.27 ± 8.46	8.46 ± 9.54 N/S	9.32 ± 8.25 N/S	9.83 ± 8.37***	2.659	0.047*
The 20-m shuttle-run (sec)	32.80 ± 17.02	36.90 ± 19.15	33.42 ± 16.6	32.18 ± 17.42	1.920	0.124 N/S
Women	(n = 152)	(n = 76)	(n = 364)	(n = 544)		
Grip strength (kg)	24.15 ± 5.62	25.01 ± 5.24	25.12 ± 6.55	25.24 ± 5.72	1.361	0.253 N/S
Sit-ups (reps/60 sec)	22.91 ± 12.44	21.71 ± 13.82 N/S	21.76 ± 12.26 N/S	19.83 ± 12.15***	3.382	0.018*
Standing long jump (cm)	144.09 ± 26.39	136.03 ± 28.68 N/S	142.22 ± 25.25 N/S	137.73 ± 26.38***	4.049	0.007**
The 50 m dash (sec)	10.96 ± 1.81	11.48 ± 2.02 N/S	11.25 ± 1.98 N/S	11.44 ± 1.99***	2.703	0.044*
Sit-and-reach (cm)	14.68 ± 9.29	14.13 ± 7.78	14.29 ± 8.60	15.13 ± 7.79	0.890	0.445 N/S
The 20-m shuttle-run (sec)	19.36 ± 8.07	18.41 ± 8.97	18.18 ± 8.03	17.81 ± 8.38	1.401	0.241 N/S

Group 1 = skipping breakfast everyday; group 2 = irregular breakfast with snack; group 3 = irregular breakfast meal; group 4 = breakfast meal everyday. N/S, not significant.

* $P < 0.05$; tested by one-way analysis of variance.

** $P < 0.01$; tested by one-way analysis of variance.

*** $P < 0.05$ compared with group 1; Tukey's post-hoc testing.

breakfast modifies the rheologic response to exercise [15]. In one study, breakfast consumption was associated with better physical fitness in university students who were adults [16]. It was also reported that breakfast consumption frequency was positively associated with muscle strength in healthy adults [17]. It was reported that having breakfast and completing a longer duration of stronger exercise affects adult bone mass [18]. Overall, skipping breakfast seems to be related to higher body mass index (BMI), worse health-related risk factors, and lower physical fitness level in adults. Nevertheless, in this study, both adult men and women in the group that had breakfast meals everyday had lower physical fitness indices compared to the group that skipped breakfast every day. This might mean that skipping breakfast is not related to physical fitness level in the adult group as the adults compared with children and adolescents have several variables, such as drinking alcohol, smoking, working, and so on. Nevertheless, we do not have information about the effects such confounding variables might have on our results. In the future, more well-designed studies are needed.

In elderly participants, skipping breakfast was associated with higher BMI and lower quality of life in the Korea study [19]. In a cohort study including elderly participants, skipping breakfast was also associated with increasing risk of mortality from circulatory diseases as well as all-cause mortality in Japan [20], meaning skipping breakfast would increase BMI and lower the physical fitness ability as well as increase health-related risk factors in the elderly. However, both elderly men and women in this study showed no significant differences in all levels of physical fitness. This might indicate that skipping breakfast is not associated with physical fitness level in the elderly, but more well-designed studies are needed to examine this effect in detail.

This study has some limitations. We were only able to evaluate the difference in levels of physical fitness based on breakfast consumption patterns; we could not assess cause and effect, only assessing the observed differences between groups. Moreover, we did not consider confounding variables, such as medical conditions. Nevertheless, this study is based on a large dataset from The Survey of National Physical Fitness project, a cross-sectional retrospective cohort

Table 3 The differences in physical fitness variables based on breakfast consumption patterns in elderly participants (aged over 65).

	Group 1	Group 2	Group 3	Group 4	Overall F	Overall P
Men	(n = 6)	(n = 14)	(n = 36)	(n = 207)		
Grip strength (kg)	26.85 ± 8.88	35.44 ± 5.20	31.83 ± 7.04	32.13 ± 7.87	1.836	0.141 N/S
Sit-ups (reps/60 sec)	15.17 ± 7.73	14.50 ± 10.33	10.50 ± 8.68	13.54 ± 10.11	1.135	0.336 N/S
Sit-to-stand (reps/30 sec)	21.00 ± 6.16	18.21 ± 7.60	18.25 ± 8.00	19.50 ± 7.80	0.449	0.718 N/S
Sit-and-reach (cm)	1.08 ± 8.14	6.91 ± 7.38	5.26 ± 8.64	4.06 ± 9.21	0.828	0.480 N/S
Back scratch (cm)	−12.98 ± 10.94	−11.25 ± 11.88	−9.71 ± 10.80	−9.23 ± 12.70	0.287	0.834 N/S
One-leg standing test with eyes open (sec)	20.86 ± 13.67	37.12 ± 30.63	21.94 ± 23.98	35.43 ± 37.18	1.822	0.144 N/S
Six-minute walk (m)	551.67 ± 143.47	612.29 ± 76.31	537.64 ± 99.91	551.62 ± 129.03	1.267	0.286 N/S
Women	(n = 9)	(n = 15)	(n = 62)	(n = 276)		
Grip strength (kg)	21.68 ± 3.45	20.34 ± 4.91	21.32 ± 5.36	20.34 ± 5.45	0.696	0.555 N/S
Sit-ups (reps/60 sec)	2.56 ± 3.78	9.07 ± 9.41	5.26 ± 6.58	5.23 ± 7.59	1.696	0.167 N/S
Sit-to-stand (reps/30 sec)	15.33 ± 9.34	15.20 ± 4.07	15.94 ± 5.66	16.42 ± 6.57	0.312	0.817 N/S
Sit-and-reach (cm)	6.29 ± 6.61	10.28 ± 9.12	12.57 ± 8.17	10.34 ± 8.68	1.942	0.122 N/S
Back scratch (cm)	−7.14 ± 6.67	−2.23 ± 6.89	−1.67 ± 10.60	−4.35 ± 10.18	1.642	0.179 N/S
One-leg standing test with eyes open (sec)	17.34 ± 10.09	16.37 ± 12.77	22.32 ± 25.50	22.80 ± 26.98	0.402	0.752 N/S
Six-minute walk (m)	506.00 ± 47.76	556.20 ± 103.06	489.29 ± 121.38	481.94 ± 140.47	1.516	0.210 N/S

Tested by one-way analysis of variance. Group 1 = skipping breakfast everyday; group 2 = irregular breakfast with snack; group 3 = irregular breakfast meal; group 4 = breakfast meal everyday. N/S, not significant.

study in Korea. Our findings should be generalizable to other research settings.

5. Conclusion

In Korean adults, physical fitness variables of sit-ups (muscular endurance), standing long jump (power) and 50m dash (speed) could be differentiated by breakfast consumption patterns. However, in the elderly population, there were no significant differences in all physical fitness variables according to breakfast consumption patterns.

Disclosure of interest

The authors declare that they have no competing interest.

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