Acute Effects of Moderate Aerobic Dance Exercise on Moods, Appetite, and Energy Intake in Young Adult Women

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Summary Energy intake (EI) has been identified as a key factor of health controlled by exercise. Aerobic dance exercise (ADEX) is a popular exercise for fitness that one can enjoy. This present study aims to examine the influence of ADEX on moods, appetite, and EI. Thirty-one young female college students completed two 1-h experimental conditions: sedentary (SED) and ADEX followed by an ad libitum lunch. Visual analog scales and measurement of salivary α-amylase activity were used to assess appetite, fatigue, and stress at preact, post act, and pre lunch, respectively. The rating of perceived exertion (RPE) of the SED or ADEX activities was measured using the Borg scale (range, 6–20). The participants completed the Profile of Mood States 2nd Edition–Adult Short at pre and post act only on the ADEX experimental day to assess the degree to which total mood disturbance (TMD), negative mood disturbance (NMD), and positive mood disturbance (PMD) have correlations with EI. In results, ADEX increased in RPE but did not affect TMD, NMD, PMD, hunger, fullness, appetite, and EI. Additionally, the ADEX-induced relative changes in EI were not determined to be significantly correlated with RPE in ADEX or the change in TMD, NMD, or PMD by ADEX. Our study suggests that ADEX does not affect mood, appetite, and EI. In addition, individual mood changes caused by ADEX do not correlate with EI in young adult women.

Key Words food intake, eating behavior, physical activity, RPE, POMS

Exercise plays a vital role in one’s health through various physiological and psychological mechanisms, and energy intake (EI) has been identified as a key factor of health controlled by exercise. Aerobic exercise expends energy and is effective in regulating weight. Additionally, aerobic exercise suppresses or has no influence on appetite or EI in healthy normal-weight and overweight people in general (1–6). Thus, this point is also effective in regulating weight. However, aerobic exercise sometimes increased EI.

The effect of aerobic exercise on EI may be influenced by the affective responses to exercise. A previous study reported a tendency (p=0.08) that increased positive affect following moderate walking exercise may lead to a reduction in EI, while decreased or no change in positive affect could increase subsequent EI in overweight women (7). Other previous studies showed that change in negative mood interacted with condition to predict EI, such that participants who reported increased negative mood during exercise consumed more calories in the active compared to the sedentary condition (8). Moreover, the rating of perceived exertion (RPE) on exercise was positively associated with EI on exercise days in normal-weight children (9). In these reports, examining the influence of affective responses to exercise on EI is important in revealing the influence of exercise on EI.

Aerobic dance exercise (ADEX) is a popular exercise for fitness that one can enjoy. ADEX is a form of physical exercise that combines rhythmic aerobic exercise
with stretching and strength training routines. ADEX can be performed in a group or individually. When ADEX is performed in a group, a sense of solidarity and competition arises, which leads to an increased motivation for exercise. ADEX can also be performed individually at home or in public places with social distance by using video and online programs.

The effect of ADEX on EI remains unclear. A previous study reported that ADEX reduced negative moods (10). However, a previous study also reported that the mood-improving effect of ADEX was significantly greater in individuals with symptoms of depressed mood before exercise (10). Thus, the influence of ADEX on mood may vary from person to person, and the effect of ADEX on EI may vary from person to person via the mood changes.

The National Health and Nutrition Survey Japan showed that young adult women have very low exercise habits and very low intention to improve these habits (11). These problems should be solved for their health promotion. ADEX could be a solution because it provides pleasure and a sense of solidarity and competition. Also, this method is safe and easy. Thus, the examination of physiological and psychological effects of ADEX on young adult women is important.

This present study aims to examine the influence of ADEX on moods, appetite, and EI. This study hypothesized that the influence of ADEX on EI varied from person to person as EI is affected by moods.

**MATERIALS AND METHODS**

**Participants.** This study recruited 31 young female college students between 19 and 20 y old at T College. This study has been approved by the ethics committee of Tsu City College (approval numbers: 17, 18, and 22). This study was conducted in accordance with the Declaration of Helsinki, and informed consent was obtained from all participants. The characteristics of the study participants are listed in Table 1. Body mass index (BMI; kg/m²) was calculated as body weight divided by squared body height. Of the 31 participants, 5 were underweight (BMI: <18.5), 25 normal (BMI: ≤18.5 to <25), and 1 preobese (BMI: ≥25 to <30). All participants were not athletes and not involved in more than 3 times per week of sports club activities.

**Study design.** The scheme of this present study is shown in Fig. 1. Moreover, this study was a controlled trial with two 1-h experimental conditions. Consequently, the participants acted on the sedentary (SED) condition. The ADEX condition was acted on after 2 wk. The SED condition rested in a seated position, and the ADEX condition performed Billy’s Bootcamp Basic Training (Good Times Video, unknown location of head office).

Each trial required participants to do their normal routine the day before and eat their standard breakfast at 6:30 and arrive at the laboratory at 8:30 on trial days. Their sleep time in the day before SED and ADEX were 383±6 min and 382±7 min. These times were not considered a problem.

The study design during the laboratory is presented in Fig. 1. Furthermore, visual analog scales (VAS) and measurement of salivary α-amylase activity were used to assess appetite, fatigue, and stress at 9:00 (pre act), 10:30 (post act), and 11:15 (pre lunch), respectively. The VAS line length was 141 mm due to a mistake in setting the scale. Additionally, the RPE of the SED or ADEX activities was measured using the Borg scale (range: 6–20) (12) at 10:30. The 1-h experimental interventions were performed with measurement of heart rate (HR) monitors, starting at 10:30.

The participants completed the Japanese Translation of the Profile of Mood States 2nd Edition–Adult Short (POMS 2-A-S) (13) at pre and post act only on the ADEX experimental day to assess the degree to which total mood (TMD), negative mood (NMD), and positive mood (PMD) have correlations with EI.

Finally, the ad libitum lunch test used to evaluate spontaneity was performed from 11:30 to 12:30. The participants were required not to eat and drink excepting zero kcal beverages from the breakfast to the lunch test.

**Exercise program.** The ADEX program, which is Billy’s Bootcamp Basic Training, is performed by imitating the image with direction and music. We chose the program because it was a very popular exercise and the digital versatile disc was easily obtainable in Japan.

![Fig. 1. Scheme of the present study. SED: sedentary, ADEX: aerobic dance exercise.](image-url)
The program is a 54-min session, which starts with an 8-min warm-up period, 43-min of aerobic dance activities including strength training, and ends with a 3-min cool-down period. In the aerobic dance session, the following movements were performed in order accompanied by up-tempo music: squat; butterfly; circling shoulder with straight arm; knee up; arm curl; shoulder press; military press; combat jab; step-in jab; hammer; hand raising; step-in combat kick; step-in front kick; jab and straight; circling arm; a combination of jab, straight, and combat kick; jumping jack; pushup; pushup runner; hip lift; hip thrust; duck walking; combat kick; twist; lying one-leg lift; lying running; sit up; sit up and knee up; keep sit up and one-leg move; keep sit up and both legs move; leg adduction; leg adduction and bent knee; and keep one leg up with a bent knee. Consequently, marching was performed between movements while standing. However, the participants rested during each motion if the exercise was difficult.

The percent heart rate reserve (%HRR) of the ADEX was calculated to assess exercise intensity using average HR using the Karvonen formula (14).

**Standard breakfast and ad libitum buffet meals.** The standard breakfast consisted of two bread rolls (139 kcal), sausage (135 kcal), and vegetables and fruit juices (81 kcal). Participants were provided ad libitum access to meals that included four kinds of rice balls, two kinds of sandwiches, Inari-sushi, steamed chicken, ham, salad, dressing, cheese, miso soup, vermicelli soup, chocolate, jelly, orange juice, and Japanese tea during the ad libitum lunch test. Moreover, the participants were required to record their meal intake. Consequently, the intake of energy; macronutrients; and sodium was also calculated. The ADEX-induced relative changes in EI were calculated as that in the ADEX condition minus that in the SED condition.

**Anthropometric, HR, and POMS 2-A-S measurements.**

Height was measured using a standard stadiometer (Endodensi Kogyo, 4D200R, Tokyo, Japan). Moreover, body weight and fat percentage were measured using an electronic scale (Tanita, MC-780A-N, Tokyo, Japan).

On HR monitors, 22 of the participants used wrist-watch type (Garmin vivosmart J HR+, Lenexa, TX, USA), 4 used chest belt type (Polar H10, Stockholm, Sweden), and 5 used chest belt type (smart heart rate belt; Suunto, Vantaa, Finland).

The POMS 2-A-S questionnaire consists of 35 items assessing the mood of the individual (15). On the one hand, the TMD score (range: −20 to 100) was calculated by subtracting the NMD score (range: 0 to 100) from the positive vigor subscale. On the other hand, the NMD score was calculated by adding the totals for the five negative subscales (i.e., anger, confusion, depression, fatigue, and tension). Furthermore, the PMD score (range: 0 to 40) was calculated by adding vigor and friendliness.

**Statistical analysis.** The Statistical Package for the Social Sciences (version 25; IBM Inc., Chicago, IL, USA) was used to perform all the statistical analyses in this study. Significance was set at $p < 0.05$. The Shapiro–Wilk test was used to test for normality. The HR data at pre act, HR average during act, %HRR of the ADEX, PMD, and nutrient intake have normality at both conditions. Thus, data were expressed as mean ± standard deviation (SD) and analyzed by parametric tests. Other data were expressed as median (range) and analyzed via nonparametric tests. The change rate of fullness measured by VAS has normality, but VAS is an ordinal scale; thus, data were expressed as median (range) and analyzed by nonparametric tests. The change rates of α-amylase activity and VAS parameters were calculated based on the values of pre act in each condition. Paired t-tests or Wilcoxon signed-rank tests were used to compare the results of HR, RPE, and nutrient intake for both experimental conditions and the results of mood measured by POMS 2-A-S for pre and post act. Moreover, the chi-square test was used to compare the results of the number of participants with EI increase or decrease at lunch test in the ADEX condition compared with the SED condition. The Friedman tests were used to compare the results of appetite, fatigue, and α-amylase activity on the effect of experimental condition and timing. In the analysis of absolute values at three time points, if significant differences were observed, the variables were analyzed using Bonferroni multiple comparison test. Consequently, Pearson or Spearman correlations were used in examining the relationship between the ADEX-induced relative changes in EI and RPE in ADEX or the change in TMD, NMD, or PMD by ADEX. The changes in TMD, NMD, and PMD were then calculated as those in post ADEX minus those in pre ADEX.

### Table 2. HR and RPE.

|                      | SED     | ADEX    | $p$ value |
|----------------------|---------|---------|-----------|
| HR at pre act (beat/min) | 68±8    | 73±7    | $p=0.002$ |
| HR average during act (beat/min) | 70±8    | 116±17  | $p<0.001$ |
| HR maximum during act (beat/min) | 98 (74–102) | 165 (129–195) | $p<0.001$ |
| %HRR                 | —       | 45.6±15.9 | —        |
| RPE                  | 7 (6–12)| 16 (12–20) | $p<0.001$ |

Values are expressed as mean±SD and analyzed by paired $t$-tests or expressed as median (range) and analyzed by Wilcoxon signed rank tests.

SED: sedentary, ADEX: aerobic dance exercise, HR: heart rate, RPE: rating of perceived exertion, %HRR: % heart rate reserve.
RESULTS

HR, RPE, and moods

Table 2 shows HR and RPE. The HR at post act, HR average and maximum during act, and RPE in the ADEX condition were determined to be significantly higher compared with the SED condition. The %HRR of the ADEX was 45.6 ± 15.9.

TMD in pre and post ADEX were 5 (−9 to 34) and −1 (−19 to 40), NMD in pre and post ADEX were 11 (−1 to 36) and 10 (1 to 41), and PMD in pre and post ADEX were 18±7 and 18±9. These mood parameters were not significantly different between that in pre and post ADEX (TMD, p=0.144; NMD, p=0.394; TMD, p=0.975). The change of the amount of TMD, NMD, and PMD from pre ADEX to after ADEX was −5 (−36 to 24), −1 (−32 to 19), and 0±6, respectively.

Change in α-amylase activity, appetite, and fatigue

Table 3 presents the absolute values and change rate of α-amylase activity, appetite, and fatigue.

Table 3. Absolute values and change rate of α-amylase activity, appetite, and fatigue.

|                        | SED          | ADEX         |
|------------------------|--------------|--------------|
| Absolute value         |              |              |
| Salivary α-amylase activity (kIU/L) |              |              |
| Pre act                | 8 (2–28)     | 8 (2–29)     |
| Post act               | 11 (2–32)    | 7 (2–39)     |
| Pre lunch              | 12 (2–37)    | 5 (3–30)     |
| Hunger (mm)            |              |              |
| Pre act                | 35 (0–117)   | 24 (0–76)    |
| Post act               | 75 (3–130)   | 56 (0–108)   |
| Pre lunch              | 108 (11–139) | 88 (19–136)  |
| Fullness (mm)          |              |              |
| Pre act                | 85 (31–134)  | 106 (34–139) |
| Post act               | 63 (5–129)   | 49 (3–108)   |
| Pre lunch              | 26 (0–90)    | 32 (2–96)    |
| Appetite (mm)          |              |              |
| Pre act                | 42 (2–80)    | 32 (0–114)   |
| Post act               | 70 (6–138)   | 57 (1–121)   |
| Pre lunch              | 93 (15–141)  | 87 (23–138)  |
| Fatigue (mm)           |              |              |
| Pre act                | 49 (3–128)   | 51 (1–110)   |
| Post act               | 49 (2–116)   | 85 (12–134)  |
| Pre lunch              | 35 (2–125)   | 60 (1–119)   |
| Change rate            |              |              |
| Salivary α-amylase activity (rate) |              |              |
| Post act               | 0.0 (−0.7–5.0) | 0.3 (−0.9–6.7) |
| Pre lunch              | 0.4 (−0.8–6.7) | −0.1 (−0.8–9.0) |
| Hunger (rate)          |              |              |
| Post act               | 0.7 (−0.1–15.7) | 0.7 (−1.0–45.5) |
| Pre lunch              | 0.8 (−0.6–7.8) | 1.3 (−0.6–8.0) |
| Fullness (rate)        |              |              |
| Post act               | −0.3 (−0.9–0.2) | −0.4 (−1.0–0.0) |
| Pre lunch              | −0.6 (−1.0–0.2) | −0.6 (−1.0–0.1) |
| Appetite (rate)        |              |              |
| Post act               | 0.4 (−0.7–34.0) | 0.4 (−0.9–16.0) |
| Pre lunch              | 1.0 (−1.0–62.5) | 1.3 (−0.3–33.0) |
| Fatigue (rate)         |              |              |
| Post act               | −0.1 (−0.9–6.8) | 0.5 (−0.7–71.0) |
| Pre lunch              | 0.0 (−0.9–2.0) | 0.4 (−1.0–15.0) |

VAS line length was 141 mm. The change rate of salivary α-amylase activity and VAS parameters were calculated based on the values of pre act in each condition. Values are expressed as median (range) and analyzed by Friedman tests.

*p<0.05, **p<0.01, ***p<0.001 for vs. SED condition. †††p<0.001 for vs. pre act. *p<0.05, **p<0.01, ***p<0.001 for vs. post act.

SED: sedentary, ADEX: aerobic dance exercise, VAS: visual analog scales.
Table 4. Energy and nutrients intake at lunch test after SED or ADEX.

|                     | SED      | ADEX     | \( p \) value |
|---------------------|----------|----------|---------------|
| EI (kcal)           | 894 ± 303| 870 ± 318| 0.585         |
| Protein intake (g)  | 37.9 ± 12.0| 34.5 ± 13.2| 0.140        |
| Fat intake (g)      | 32.8 ± 14.1| 32.2 ± 16.4| 0.792        |
| Carbohydrate intake (g) | 112 ± 47 | 110 ± 47  | 0.851       |
| Sodium intake (mg)  | 2,833 ± 1,037| 2,587 ± 813| 0.055       |

Values are expressed as mean ± SD and analyzed by paired t-tests. SED: sedentary, ADEX: aerobic dance exercise, EI: energy intake.

DISCUSSION

This present study aims to examine the influence of ADEX on moods, appetite, and EI. The %HRR of the ADEX was 45.6 ± 15.9. This study demonstrated that ADEX increased in RPE but did not affect TMD, NMD, PMD, hunger, fullness, appetite, and EI in young adult women. Additionally, the ADEX-induced relative changes in EI were not determined to be significantly correlated with RPE in ADEX or the change in TMD, NMD, or PMD by ADEX. These results were inconsistent with the hypothesis of this study.

The physiological exercise intensity of the ADEX in this present study, that is, 45.6 ± 15.9 %HRR (Table 2), could be considered to be of moderate intensity for the participants (15, 16). Meanwhile, the RPE of the ADEX was 16 (12 to 20). Thus, the psychological exercise intensity of the ADEX could be considered to be of vigorous intensity for the participants (15, 16). We consid-
ered that the difference between physiological and psychological intensities was caused by the present ADEX program. The present ADEX program was not a continuation of the same motion but various motions including strength training and high-speed motion unlike typical aerobic exercises such as running and cycling. Thus, temporary increases in working load could increase the psychological intensity of this present ADEX.

As per our findings, the ADEX did not have an effect on TMD, NMD, and PMD. These results were contrary to previous reports wherein ADEX decreased in the negative mood (10) and increased in the positive mood (17), but were similar with another report (18). We consider that the difference of ADEX influence on moods was because each ADEX program was not the same. ADEX include various movements and countless programs. The results of the present and previous studies suggest that some ADEX improves moods, while others have no notable effect on moods. Meanwhile, ADEX caused a lower change rate of α-amylase activity at pre lunch (Table 3). Salivary α-amylase activity is a biomarker for psychosocial stress (19, 20). ADEX in this present study may decrease psychosocial stress without their awareness.

ADEX probably increased energy expenditure (no data), but did not affect hunger, fullness, appetite, and EI (Tables 3, 4). These results were similar to previous studies on aerobic exercise (2, 4–6). However, the ADEX-induced relative changes in EI were not correlated with RPE in ADEX or the change in TMD, NMD, or PMD by ADEX. Further, these results were also not consistent with other previous studies on aerobic exercise (8, 9). The different results between the present and previous study may be due to the difference in the participants. It is not about exercise, but a meta-analysis has reported that induced negative mood was significantly associated with greater food intake, especially in restrained and binge eaters (21). Overweight women were the participants in the previous studies of change in moods by exercise affecting EI (7, 8). Additionally, children 9–12 y old were participants in the previous study of being positively correlation with RPE of exercise and EI. Most of the participants in this present study were normal-weight young adult women. Thus, the influence of change in moods by exercise and RPE of exercise on EI may be more common for non-normal-weight people and children but unlikely for normal-weight young adults.

In this study, the ADEX program used Billy’s Bootcamp Basic Training because of its popularity and ease of use. Aside from the resultant mood, the effects of ADEX on EI may differ between the Billy’s Bootcamp Basic Training program and other programs. ADEX is a combination of multiple motions and not a repetition of motions, such as running and cycling. Therefore, there are few programs with a same motion pattern. Different motion patterns can have different physiological and psychological effects. Further investigation of the effects of various ADEX programs on EI is necessary.

This study has the following limitations. First, only the acute influence of a single ADEX on moods, appetite, and EI was examined. This study did not investigate the influence of a single ADEX following dinner or the next day and the influence of a habitual ADEX training program. Second, all participants performed the SED condition prior to performing the ADEX condition. The nonrandomized experimental condition may affect the results of this study. Third, the participants were not restricted to drink zero kcal beverages from the breakfast to the lunch test because of preventing dehydration. Some participants drank a zero kcal sports drink. It may affect result of the lunch test. Fourth, the menstrual cycle phase during the trial was not examined and lacks unity. The menstrual cycle phase also has an effect on appetite and EI, as the luteal phase increases hunger and EI (22). The number of participants was over 30, but there might be a bias in the menstrual cycle that might affect the results. Finally, the mechanism (e.g., brain activity or stress and appetite hormones) about the influence on moods, appetite, and EI was not investigated. Nevertheless, this study considers that the current data contribute to revealing the influence of ADEX on EI despite these limitations.

In conclusion, to the best of our knowledge, this is the first study to examine the influence of ADEX on appetite and EI with moods in young adult women. This study suggests that ADEX does not affect mood, appetite, and EI. In addition, individual mood changes caused by ADEX do not correlate with EI in young adult women.

**Authorship**

YA designed the research. MH and YT modified the research methods. YA performed the experiment and analyzed the data. AY, AH, KF, and YT advised the analysis. YA wrote the manuscript. AY, AH, KF, SF, YO, KS, and YT modified the manuscript. YA had the primary responsibility for the final content. All authors have read and approved the final manuscript.

**Disclosure of state of COI**

The authors declare that they have no conflict of interest.

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