

SHORT COMMUNICATION

A randomised trial on walking exercise and banana consumption on self-reported depression symptoms among female adolescents in Surakarta, Indonesia

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ABSTRACT

Introduction: Depression disrupts an individual's well-being and is linked to the risk of degenerative disease. Previous studies suggested the effect of exercise and banana intake could induce the production of hormones that promote relaxation. This study examined the association between walking exercise and banana consumption on self-reported depression symptoms in female adolescents. **Methods:** This was a randomised controlled trial conducted in four high schools purposively selected in Surakarta. By using the Lemeshow formula, a total of 64 female students were recruited. Inclusion criteria were ages 15-17 years, normal body mass index (BMI)-for-age, consuming fruit <3 x/d, physical exercise <3 x/wk, non-smoking, non alcohol consumer, and not menstruating during study. The subjects were randomly distributed into four groups for the two-weeks study: (1) walking exercise daily for 1.6 km under 23 min, at a speed of 3.8 km/h on a treadmill; (2) banana intake of 2 servings daily (130 g/serving); (3) walking exercise and banana intake; and (4) control not prescribed banana or walking exercise. Self-reported depression symptoms was assessed by the Beck Depression Inventory II (BDI-II) questionnaire. Data were analysed using the linear regression model. **Results:** Banana consumption only ($MD=-4.50$, $SE=1.92$) and combination of walking exercise and banana consumption ($MD=-5.36$, $SD=1.95$) groups showed significantly lower depression scores at the end of intervention compared to the control group ($p<0.05$). **Conclusion:** Prescribed banana consumption or a combination of banana consumption and walking exercise showed potential for reducing self-reported depression symptoms among female adolescents.

Keywords: walking exercise, banana, depressive symptoms

INTRODUCTION

In 2015, 4.4% or 322 million people world-wide suffered from depression, which affects more women than men (5.1% and 3.6%, respectively) (WHO, 2017). As a single factor, it contributes

to 4.3% of the burden of disability in the world in 2000 (WHO, 2013; Kessler *et al.*, 2013).

A nationally representative survey of adolescents aged 13-18 years in United States revealed 32% had anxiety disorders (Merikangas *et al.*, 2010). In

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Indonesia, the prevalence of mental health disorders characterised by depression symptoms was 6.0% among ages 15 years and older (Ministry of Health, Indonesia, 2013).

Lack of exercise was reported to be associated with an increased risk of depression (Hiles *et al.*, 2017). The review of Morgan *et al.* (2015) reported that exercise induces numerous molecular and neuronal adaptations in the brain stem, hypothalamus and basal ganglia. Exercise is known to increase β -endorphin, serotonin, dopamine, and norepinephrin and normalise cortisol levels (Melancon *et al.*, 2014; Sariss *et al.*, 2012; Morgan *et al.*, 2015). As such, exercise could be an alternative treatment or adjuvant for depression (Cleare *et al.*, 2015). Walking as an exercise decreases the grade of depression of pulmonary cancer patients (Chen *et al.*, 2015). An association between a high-quality diet of fruits and vegetables (≥ 5 times a day) with a lower risk of depression was reported in adults (Jacka *et al.*, 2011). Individuals who consumed more fruits and vegetables were associated with better mental health such as lower risk of depression (Carr *et al.*, 2013; Kulkarni *et al.*, 2015; McMartin *et al.*, 2013). Fruits are an important component of a low-energy healthy diet and are rich in vitamins, minerals, and numerous bioactive compounds with potential effects on brain health (Biswajit *et al.*, 2017). Bananas contain phenolics, carotenoids, biogenic amines, phytosterols, and minerals that have been associated with reduction of oxidative damage in cell membrane, and depression (Singh *et al.*, 2016; Scapagnini *et al.*, 2012). Bananas are reportedly used for treating depression in Iran and India (Tavakkoli-Kakhki *et al.*, 2014; Kumar *et al.*, 2012).

Depressed adolescents are likely to be more susceptible to eating disorders, dependency on drugs, and suicidal

tendency (Thapar *et al.*, 2012). Studies have shown gender differences in patients with mental disorders, i.e. higher incidence of mood and anxiety disorders among females. Halley *et al.* (2013) found that more than half of the women population with depression experienced severe symptoms of depression during menstruation. Estrogen levels are 5-8 times higher compared to non-menstruation periods, and estrogen has a positive impact on corticotropin releasing factor (CRF). Findings of gender differences in CRF receptor signalling results in an enhanced arousal response and a compromised ability to adapt to chronic stress in females (Valentino *et al.*, 2012).

MATERIALS AND METHODS

This was a randomised controlled study conducted in four high schools purposively selected in Surakarta, Central Java. The inclusion criteria were: female adolescents aged 15-17 years, had a normal nutritional status [BMI-for-age z-score ($\geq -2SD$ - $\leq +1SD$)], reported fruit intake of < 3 servings/d, exercise < 3 times/wk, did not smoke and drink alcohol. Individuals with history of asthma or cardiac disease, an allergy to bananas, currently on an antidepressant course, taking omega-3 fatty acid supplements daily in the last one month, were excluded from the study. Screening was performed on subjects who filled out the demographic questionnaire. Body weight and height measurements were taken for calculating body mass index. It was conducted for a 2 wk period and another 2 wk washout period in-between from January 2018 to March 2018. The subjects gave informed consent and anonymity was maintained. By applying Lameshow formula, 44 subjects were calculated by adding 40% of total samples (Dettori, 2011). A total of 64 subjects were recruited and

randomised into four groups: (1) walking exercise only; (2) consuming banana only; (3) walking exercise and consuming banana and (4) control without walking exercise and consuming banana. They were asked to maintain their regular daily activities and diet (see Figure 1).

Walking exercise was performed 3 times/wk throughout the 2-weeks study. The exercise velocity, frequency, duration, and distance were all conducted and recorded under supervision. In each exercise session, each subject had to walk a distance of 1.6 km under 23 min, at a speed of 3.8 km/h on a treadmill (Precor 956i USA) in a fitness centre. During the

exercise, subjects were accompanied by an instructor, and had a 5 min warm-up at the start and a 5 min cool down at the end. A piece of banana (*Musa Paradisaca var Sapientum L Kuntze*), also known as Ambon banana, was served two times/day (130 g/serving) throughout the 2 wk study. The bananas were weighed to ensure consistency of weight per serving.

The Beck Depression Inventory-II (BDI-II) questionnaire was selected as its validity and reliability for the general population of Indonesia was shown to have a Cronbach's alpha coefficient of >0.90 (Ginting *et al.*, 2013). It consists of 21 questions, each being scored on

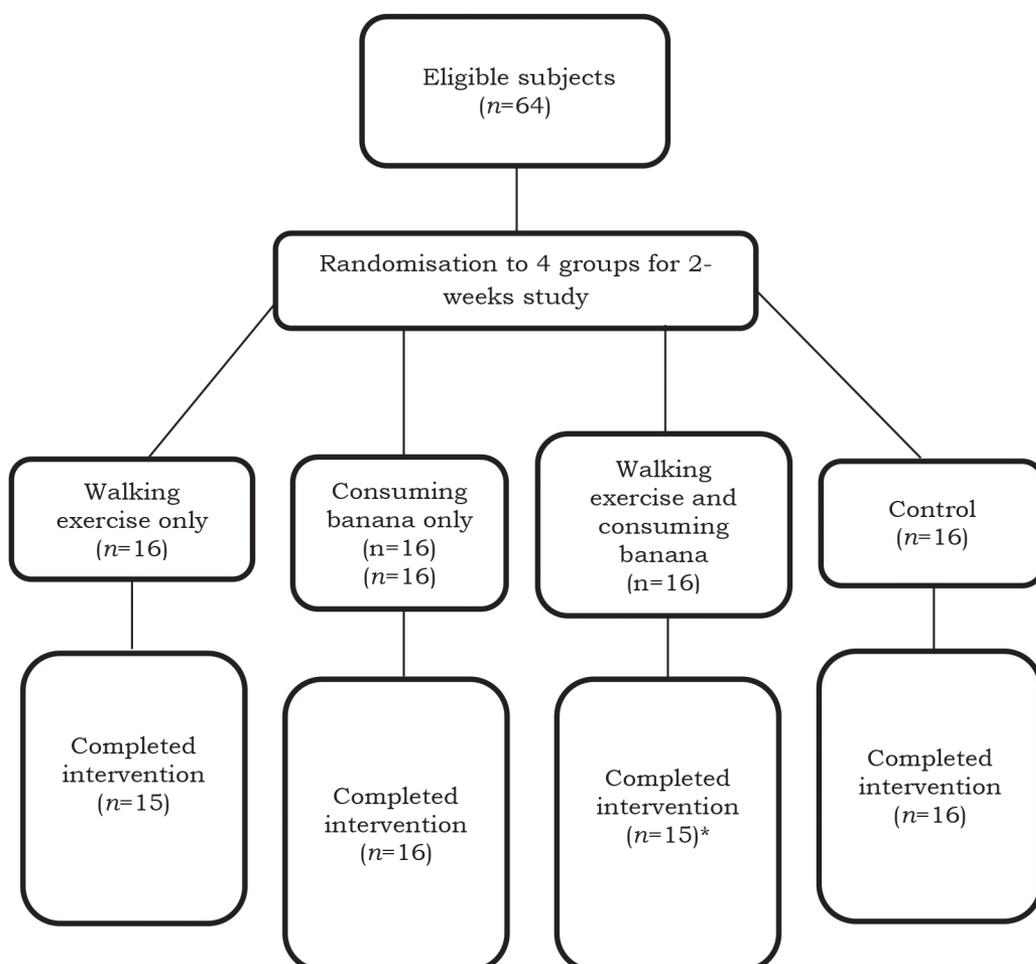


Figure 1. Study flow diagram of subjects randomised into four intervention groups

a scale value of 0 to 3, hence, the total score ranged from 0-63. Higher total scores indicate the presence of severe symptoms of depressive disorders:

- Score of 14–19: mild depression
- Score of 20–28: moderate depression
- Score of 29–63: severe depression

The subjects completed the Beck Depression Inventory questionnaire both before and at the end of the 2 wk intervention study.

IBM SPSS statistics v. 21 software was used for statistical analyses. Data normality was determined using the Kolmogorov-Smirnov test; while the homogeneity of the data was tested using the Levene test. Paired *t*-test was performed to describe the differences in the symptoms of depression before and after intervention with a $p < 0.01$. In order to evaluate the effect of the intervention on all four groups, a one-way ANOVA

was conducted followed by a post-hoc least significant difference (LSD) test with significance of $p < 0.05$.

The study protocol was approved by the institutional review board of Health Research Ethics Committee of *Rumah Sakit Umum Daerah* (RSDU) Dr Moewardi, and Faculty of Medicine Universitas Sebelas Maret Surakarta with ethical number 1.175/XII/HREC/2017, and all procedures involving human subjects were performed in accordance with ethical standards.

RESULTS

There were significant differences in the self-reported scores for depression symptoms between each of the treatment groups and control before and after the intervention. Walking exercise only, consuming banana

Table 1. Differences in self-reported depression symptoms scores before and after intervention

Group	Before Intervention (M±SD)	After Intervention (M±SD)	Paired t-test	p-value
Walking exercise only	17.27±5.02	10.00±5.37	7.08	<0.001***
Banana consumption only	15.44±6.86	8.06±6.50	6.75	<0.001***
Walking exercise and banana consumption	13.27±4.02	7.20±4.81	6.26	<0.001***
Control	14.44±4.98	12.56±4.80	2.59	0.020*

* $p < 0.05$; *** $p < 0.001$

Table 2. Results of post-hoc test among intervention groups

Group	Mean Difference	SE	p-value	95% CI
Walking exercise only vs control	-2.563	1.951	0.194	-8.34, -0.66
Banana consumption only vs control	-4.500	1.919	0.022*	-6.47, 1.34
Banana consumption vs walking exercise	-1.938	1.951	0.325	-5.84, 1.97
Walking exercise and banana consumption vs control	-5.363	1.951	0.008*	-9.27, 1.46
Walking exercise and banana consumption vs walking exercise only	-2.800	1.982	0.163	-6.77, 1.17
Walking exercise and banana consumption vs banana consumption only	-0.863	1.951	0.660	-1.97, 5.84

SE=Standard error; CI=Confidence interval; * $p < 0.05$

only, and the combined walking and banana consumption groups showed significantly lower depression symptoms scores compared to the control group (Table 1).

The post-hoc LSD test showed significant differences in the average depression scores between the banana consumption only group, the combined walking exercise and banana consumption group and the control group ($p=0.022$ and $p=0.008$, respectively) (Table 2).

DISCUSSION

To the best of our knowledge, this is the first study that investigated the impact of walking exercise and banana diet on self-reported symptoms of depression in a sample of female adolescents in Surakarta, Indonesia. The study showed that walking exercise, banana consumption, or combined showed potential of lessening self-reported depression symptoms. However, caution should be exercised when using the BDI-II "as a screen in nonpsychiatric populations where the base rate for major depression may be substantially lower" (Beck *et al.*, 1996).

Research has shown exercise to be an alternative, effective treatment for depression (Rethorst & Trivedi, 2013). In a meta analysis of exercise as a treatment for depression, Kvam *et al.* (2016) reported that physical exercise showed a significant effect on unipolar depression compared to control condition. Walking was the most preferred form of exercise, requires low expenses and is easy to perform (Busch *et al.*, 2016). Chen *et al.* (2015) found that 40 min of walking per day, 3 times/wk for 12 wk may reduce anxiety and depression in pulmonary cancer outpatients. However, Vanroy *et al.* (2017), found that 10 wk of walking exercise did not reduce depression in adults.

Walking on a treadmill for 30-45 min/wk for 8 wk may reduce the symptoms of depression in male and female patients of 18-30 years of age with major depression disorder (Olson *et al.*, 2017). Other studies that combined walking exercise and pharmacologic treatments showed that 6.4 km/h walks for 210 min/wk were associated with a greater improvement of depressive symptoms versus 4.8 km/h walks for 75 min/wk (Trivedi *et al.*, 2011).

A study of 100 college students with an average age of 19 years showed that snacking on one apple or banana daily for 10 days reduced their anxiety disorder compared to taking chocolate wafer or potato chips (Smith & Rogers, 2014). Carr *et al.* (2013) found that males aged 15-35 years who ate two kiwi fruits daily for 6 wk had reduced depression scores. Another study reported that adults who consumed a fruit and a vegetable for 14 d, showed decreased symptoms of depression, although the change was not statistically significant (Conner *et al.*, 2017).

The limitation of this study was the inability to control the homogeneity of dietary habits, food intake and other sports activity among subjects, as the movement of the subjects was not restricted.

CONCLUSION

Banana consumption only, or combined banana consumption and walking exercise as prescribed in this study for two weeks showed potential as an option to current strategies for treating depression symptoms. More studies are suggested using various types of fruit and exercise on a larger sample size.

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Authors' contributions

PES, conceptualised and designed the study, prepared the draft, led the data collection, created the manuscript; WB led the data collection, advised on data analysis and interpretation, and reviewed the manuscript; AS led the data collection, advised on data analysis and interpretation, and reviewed the manuscript.

Conflict of interest

The authors declare no conflict of interest and no financial interests.

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