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Nutrition Module Application in Physical Education to Increase Fruit and Vegetable Consumption in School Children

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ABSTRACT

The objective of this study is to apply nutrition modules during PE in an effort to increase fruit and vegetable consumption in students. The method for this study was quasi-experimental with a randomized pretest-posttest control group design. A sample number (i.e. 60 subjects from Denpasar, Indonesia and 60 subjects from Mataram, Indonesia) was taken randomly and research was conducted for three months in two stages, i.e. the training of PE teachers on the use and application of the nutrition modules during PE lessons. Collected data were fruit and vegetable consumption using the 24-hour recall method and food frequency questionnaire, physical fitness using a physical test, and the students' knowledge using a questionnaire distributed at the beginning and at the end of the intervention. Data analysis was performed using paired T-test and independent T-test. The results illustrated a significant increase in the average of knowledge after the intervention for both subjects in Denpasar (62.5±9.0) and Mataram (82.3±14.8), as well as an increase in the average fruit and vegetable consumption for subjects in Denpasar (67.6±9.0 g/day) and Mataram (81.8±14.8 g/day). However, no significant difference was found on the average level of physical fitness for subjects in Denpasar (4.1±0.6) and Mataram (4.6±0.7). It was concluded that the module application during PE can increase fruit and vegetable consumption in students. To foster the children's habit of consuming fruit and vegetables, support from the teachers and family of the children are required to encourage a change in their behavior to consume fruit and vegetables.

Keywords: fruit and vegetable consumption, knowledge, nutrition module, physical education, students

INTRODUCTION

The micro nutrients found in fruit and vegetables are very necessary for the development of school-aged children. Fruit and green vegetables are rich in vitamin A and vitamin C is known as a source of antioxidants beneficial in preventing obesity in teenagers (Hilger-Kolbe *et al.* 2017).

The obesity rates in Bali, Indonesia in 2017 were above the national prevalence (3%), where student obesity rates in Denpasar contributed to the high rates (0.16%) (Permana & Aditya 2017). Meanwhile, in Mataram, the rate of overnutrition was 1% higher than the rates of the West Nusa Tenggara province (0.9%). The increase in Indonesian obesity prevalence (21.8%) was caused by lack of physical activity, consuming food that is high in calories but low in fiber, and the habit of consuming soft-drinks that contain much sugar (Dikes NTB 2017).

The national average for the inadequate consumption of fruit and vegetable behavior according to Basic Health Research (MoH 2017a) was 93.5%. Dietary Guidelines for Americans recommends a minimum of five portions of fruit and vegetable consumption in a day. This is almost the same as the Balance Nutrition Pyramid which recommends 5–8 portions of fruit and vegetables which is equivalent to 400–600 g. Inadequate consumption of fruit and vegetables correlates to the development of obesity (Olfert *et al.* 2018).

A survey conducted in Denpasar on the consumption of fruit and vegetables in 2017 reported a decrease from 27.68 % to 26.74%, while the target score of PPH (Expected Food Pattern) fruit and vegetable consumption is

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30%. The survey also mentioned that the fruit and vegetable consumption of students in Denpasar (88%) was below the recommended amount (Riswanda 2018).

An almost similar situation was found in Mataram, where fruit and vegetable consumption reached 53.98%. Research by Fauziah (2014) showed that there is a significant relation between the knowledge and eating behavior of college students after incorporating nutritional science in PE lessons. A previous study showed that 80% of parents support a school-based nutrition program to promote fruit and vegetable consumption, but guidance was needed to reduce errors/mishandling in preparing suitable fruit and vegetables for students (Jongenelis *et al.* 2018).

Repeated exposure to nutritional education is very effective for promoting fruit and vegetable consumption in children; however, it gave no effect to the variations of fruit and vegetable selection (Ahern 2019). The modules as learning medias can encourage students to learn according to their ability and to apply the knowledge well (Perdana *et al.* 2018). As consideration, there is inadequate fruit and vegetable consumption among students in Denpasar (88.1%) and Mataram (53.8%), while PE lessons are a way for students to learn while playing, so they can appreciate the knowledge and skills that they worked for. This study offers scientific evidence regarding nutrition modules integrated into PE lessons, its impacts on the students' knowledge, fruit and vegetable intake and physical fitness. The purpose of this study is to determine the effect of the application of nutrition modules in PE lessons on the change of fruit and vegetable intake.

METHODS

Design, location, and time

This research uses the experimental study design by using a pre-test and post-test with a control group. It was conducted in three months, from August 2019 to October 2019 and took place in four State Primary Schools (SDN) in Denpasar (2 schools) and Mataram (2 schools).

The schools were chosen as the research location because they were the schools where the Mataram Health Polytechnic and the Denpasar Health Polytechnic both conducted their community service program. The data collection was carried out in Mataram and Denpasar and data was processed in Mataram. This study included humans as subjects with an ethic approval number: LB.01.03 / 1.1 / 3356/2019.

Sampling

The research subjects were Grade 5 Primary School students. A sample number of 60 subjects from both Denpasar and Mataram was taken randomly with the following inclusion criteria: participated in PE lessons, always attended the class during the study period, and signed an inform consent to participate in the study. The exclusion criterion was sick students.

Data collection

The nutrition modules were prepared and went through a trial test before the primary data collection was conducted. The modules were tested both in Denpasar and Mataram in schools different to the main research location with a total sample of 32 Grade 5 students.

The purpose of the trial test was to figure out how PE teachers should integrate the nutrition modules into their lessons. In the module trial phase, PE teachers developed the materials by following the module guidelines which was in accordance with the aims of the program. After a successful trial, training sessions for the use of the modules were held for the PE teachers of the intervention group.

Four training meetings were held in June 2019 with a 3-hour duration for each meeting. The control group did not implement the nutrition module and only followed the Standard Operating Procedures of the school. Sample size calculations used minimal samples (30 people for each treatment) for experimental research.

The subjects in Denpasar and Mataram were divided into two groups, namely the control and intervention group. The control group subjects were given 100 grams of fresh fruit and 100 grams of processed vegetables alternately after PE class every week. The control group was given some snacks that were not fruit and vegetable based.

The data collection process was carried out twice, at the beginning and at the end of the study in selected primary schools and with students who met the inclusion criteria. Data collected on student knowledge was measured on the questionnaire using a scale category of good (80–100), fair (60–79) and poor (<59).

Data were collected on fruit and vegetable intake with 24-hour recall forms and food frequency questionnaires, the results were then compared to the recommended adequacy for students (Recommended Dietary Allowances 2017).

Physical activity (running 400 meters) was measured with a stop watch and the finishing time was put in the table of the students' fitness level. The level was divided into a scale category of good (2'10"–2'30"), fair (2'31"–2'45") and poor (2'46"–3'44"). The data on the students' fitness level were collected at the beginning and during the intervention period, once every week during PE lessons.

Nutrition module materials were given in a course of 12 meetings. The material was given one day before the PE class schedule with a different topic for each meeting. During the PE lessons the teacher asked the subjects some questions, which was followed by running (400 meters) to get the correct answer. The same procedure was implemented in the control group; the difference was that no nutrition modules were applied.

Data analysis

The data analysis used were univariate , bivariate, and multi variate analyses with a significant level of ($p \leq 0.05$). Univariate analysis was used to distribute subject characteristics (age, gender, knowledge, fruit and vegetable consumption, energy consumption, physical fitness, nutrition status), while bivariate analysis (independent T-test and Paired T-test) was used to analyze the difference between each sample, knowledge, physical fitness, and fruit and vegetable consumption before and after intervention. Multivariate analysis was used to analyze methods and to analyze the direct and indirect influence of the independent variable (knowledge and physical fitness) on the dependent variable (fruit and vegetable consumption), which was seen through the coefficient score in the form of a diagram with an arrow in one way theory with a Path Analysis significant at $p<0.05$.

RESULTS AND DISCUSSION

Subject characteristics

Children aged 9–12 years old are still in the process of growing and have eating habits of consuming high calorie low fiber food, so obesity often develops because of the unbalanced nutritional consumption (Brytek-Matera *et al.* 2018). This study found the average subject age to be (10±0.68) years old, with a proportion of 63.7% female and 33.7% male for subjects in Denpasar, which was the opposite to the subjects in Mataram (male 63.7% and female 33.7%), as shown on Table 1.

Nutrition Knowledge. Knowledge is an information with understanding, which is one of the most important and fundamental forms of attitude and behavior. The students' knowledge on fruit and vegetables are mostly categorized as low (50.8 %). Topics that most of the subjects failed to answer were questions about the benefits of eating fruit and vegetables (75%), fruit and vegetable intake requirements (95.8%), fruit and vegetable processing (80.4%) and the consequences of low fruit and vegetable intake (75,6%). A study by Ferwanda (2017) found that only 5.4% of elementary school students have good knowledge about fruit and vegetables. Trude *et al.* (2018) mentions that food choice attitudes and behaviour is made based on knowledge in order to be directly applied.

Physical Fitness. Physical activity through PE lessons is planned in a structured, repetitive manner so that physical fitness is increased and can be maintained (Hickey *et al.* 2016). Table 1 illustrates that 42.5% of students had very good physical fitness; both the case and the control group had an average physical fitness score of 3.75. In accordance to a previous study by Slagter *et al*. (2018), physical activities such as doing sports in school is done with the aim of developing healthy and fit students so that they can perform everyday activities in school. A fit body can also improve their learning achievements.

Nutrient Intake. Energy consumption levels are the energy content consumed by the students compared to the adequacy figure. This research shows (Table 1) that most of the students are in the deficit weight category (64.2%). Dietary consumption relates to the types and quantities of food consumed. This is shown on Table 1 where most of the students are in the deficit category for carbohydrates (61.4%), fat (62.5%), and protein (63.3%). A study by Salimar *et al.* (2014) also showed that 64.4% of school children are classified as underweight. Low macro nutrient intake can cause a disruption of fo intake to the brain, which can lower study concentration and physical fitness.

Table 1. Distribution of subject characteristics

Subject characteristics	City				Total	
	Denpasar		Mataram			
	n	%	n	%	n	%
Gender						
Man	11	36.7	19	63.3	30	50.0
Woman	19	63.3	11	36.7	30	50.0
Age (years)						
9	2	6.7	3	10.0	5	8.3
10	25	83.3	18	60.0	43	71.7
11	3	10.0	8	26.7	11	18.3
12	0	0.0	1	3.3	1	1.7
Knowledge						
Good	1	3.4	0	0.0	23	19.2
Moderate	10	33.3	5	16.7	36	30.0
Poor	19	63.3	25	83.3	61	50.8
Energy consumption						
Above sufficiency	0	0.0	0	0.0	2	1.7
Normal	1	3.3	2	6.7	10	8.3
Mild deficit	4	13.3	6	20.0	18	15.0
Moderate deficit	4	13.3	5	16.7	13	10.8
Severe deficit	21	70.1	17	56.6	77	64.2
Fruit & Vegetables consumption						
Appropriate	2	6.7	0	0.0	3	2.5
Unsuitable	28	93.3	30	100.0	117	97.5

Food and vegetable consumption. A varied and adequate amount of fruit and vegetable consumption is beneficial in fulfilling nutritional and health requirements, therefore it is recommended that it is introduced at an early age. Table 1 shows that the fruit and vegetable intake of school children (97.5%) is less than sufficient. Schwedhelm *et al.* (2019) hypothesized that eating habits that are applied since childhood affect dietary patterns as adults. This is in line with the results of the research by Attrop *et al.* (2014), where nearly 85.8% of the children in Colombia consume fruits and vegetables that are less than the recommended intake.

Comparison of physical fitness, knowledge, and fruit and vegetable consumption between groups

Data in Table 2 illustrates that there were no average differences of physical fitness, knowledge, and fruit and vegetable consumption for all groups ($p > 0.05$).

Tablel 2. Independent T-test analysis

	F	Sig	Sig (2 –tailed)
Denpasar			
Case			
Physical fitness	0.915	0.345	0.107
Knowledge	11.510	0.061	0.000
Fruit & vegetabkes consumption	0.022	0.882	0.041
Control			
Physical fitness	3.318	0.074	0.867
Knowledge	0.362	0.558	0.078
Fruit & vegetabkes consumption	6.914	0.110	0.242
Mataram			
Case			
Physical fitness	2.047	0.158	0.242
Knowledge	0.657	0.657	0.000
Fruit & vegetabkes consumption	4.028	0.049	0.000
Control			
Physical fitness	1.206	0.459	0.103
Knowledge	6.516	0.111	0.124
Fruit & vegetables consumption	1.206	0.277	0.224

While Table 3 shows that there were differences in knowledge (27.45% in Denpasar and 55% in Mataram), fruit and vegetable intake (28.8% Denpasar and 52% Mataram) for the intervention and control groups, although they are still below the recommendations (300–400 g/day) and these increases were significantly different ($p \leq 0.05$). The increase in fruit and vegetable consumption occurred due to repeated exposure, causing the students' understanding and knowledge to increase. Consuming fruits and vegetables with every meal helps the mental and physical development of children (Dampang *et al.* 2018).

A good level of physical fitness can make it easier for subjects to learn and understand their lessons so they can be applied in everyday life. Table 3 shows the average level of physical fitness before and after the intervention, which is in the good category and has no significant difference ($p>0.05$). Factors that caused no difference to physical fitness in this study were due to the students being in the same age group (9–12 years), students always walking to school and studying in a clean school environment.

A clean environment is the main asset of physical and spiritual wellbeing. This is in accordance with Sharkey's opinion that the level of physical fitness is not only determined by exercise, but there are other factors that play a role such as age, gender, environment, food and genetics (Sharkey 2003).

Path analysis

Table 4 Model 1 shows that there was no significant relationship between knowledge and the consumption of fruits and vegetables ($p=0.026$ and $p=0.194$) for both subjects in Denpasar and

Table 3. The differences of knowledge, physical fitness, fruit and vegetable consumption of school children before and after the study in the control group and case group in Denpasar and Mataram

Variable	Control			Cases		
	Mean±SD			Mean±SD		
	Before	After	Significant (p)	Before	After	Significant (p)
Denpasar city						
Knowledge	34.7±13.6	41.0±13.7	0.105	47.3±15.7	65.2±9.0	0.000
Physical fitness	3.7±0.9	3.7±0.9	0.343	3.8±0.8	4.1±0.6	0.867
Fruit and vegetables consumption	84.0±37.9	103.0±79.4	0.261	121.3±93.3	170.6±86.6	0.000
Mataram city						
Knowledge	36.0±15.7	57.3±7.8	0.000	36.3±16.5	82.3±14.8	0.000
Physical fitness	4.6±0.8	4.3±0.8	0.377	4.5±0.8	4.6±0.7	0.103
Fruit and vegetables consumption	56.3±68.9	102.3±93.3	0.000	80.8±73.3	168.9±95	0.002

Mataram; this is inversely proportional to the research results of Ramadhani and Hidayati (2017) that concluded that the knowledge of school-age children had a significant relationship with fruit and vegetable consumption. The low consumption of fruits and vegetables was caused by low availability both at school and at home. A study by Farida (2012) concluded that children with inadequate availability of fruit and vegetables at home have a 4.5 times greater chance of having less consumption than those with good availability.

From Table 4 Model 2 we can see that there is no significant relationship between knowledge and nutrient intake (p=0.092 and p=0.098) for the subjects in Denpasar and Mataram. This result is conflicting with the result by Kanah (2020), in which a significant relationship was found between knowledge and consumption (p=0.001). Moreover, Sponk (2014) also showed a significant relationship (r<0.5) between knowledge and consumption.

Table 4 Models 1 and 2 showed that there was no significant relationship between physical fitness and fruit and vegetable consumption (p=-0.092 and p=0.098) and nutrient consumption (p=0.263 and p=-0.193) (Denpasar and Mataram). This is similar to the research of Cohen (2017), which showed no significant relationship (p<0.002) between physical fitness and fruit and vegetable consumption (r=0.77). This is different to the Södergen (2012) study which showed a significant relationship (p≤0.05) between physical fitness and fruit and vegetable consumption.

Direct influence of knowledge and physical fitness on fruit and vegetables consumption and nutrient consumption

According to the path analysis (Figure 1 and 2), it can be seen that knowledge has a weak effect on all variables. The results showed that there was a direct and positive relationship between knowledge and the consumption of fruit and vegetables with a coefficient of 0.1223, which means that 12% of fruit and vegetable consumption was directly influenced by knowledge and the remaining 88% was influenced

Table 4. Model of coefficient path analysis of consumption among school children

Model	Coefficient	Significance
Denpasar city		
Model 1		
Knowledge	0.1223	0.206
Physical fitness	-0.0969	-0.080
Model 2		
Knowledge	0.2324	0.092
Physical fitness	0.1351	0.263
Mataram		
Model 1		
Knowledge	-0.0860	0.194
Physical fitness	-0.1407	-0.149
Model 2		
Knowledge	0.2294	0.098
Physical fitness	-0.0956	-0.193

*Path analysis significant at p<0.05

by other factors. On the other hand, there is also a direct relationship between knowledge and consumption of nutrients (coefficient 0.2324). This means that knowledge has a weak relationship with nutrient consumption at 23% and 77% is influenced by other factors. These results are also not much different from the subject in Mataram.

Based on Figures 1 and 2, the path coefficient showed that there was a negative relationship between physical fitness and fruit and vegetable consumption (coefficient value -0.0967) and nutrient consumption (coefficient value -0.0956). This means that physical fitness can affect 10% of fruit and vegetable consumption, 10% of nutrient consumption and the remaining 90% are due to other factors.

Indirect Effect of knowledge and physical fitness on fruit and vegetable consumption and nutrient consumption

In this research, it can be concluded that the physical fitness variable does not directly affect

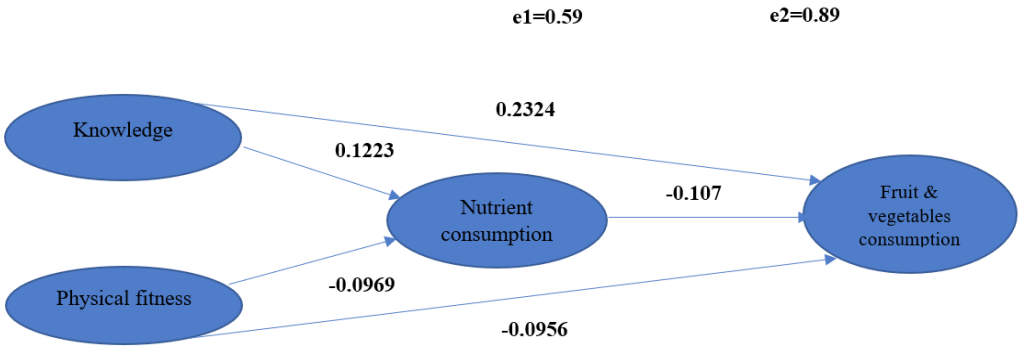

Figure 1. Path analysis diagram (Denpasar)

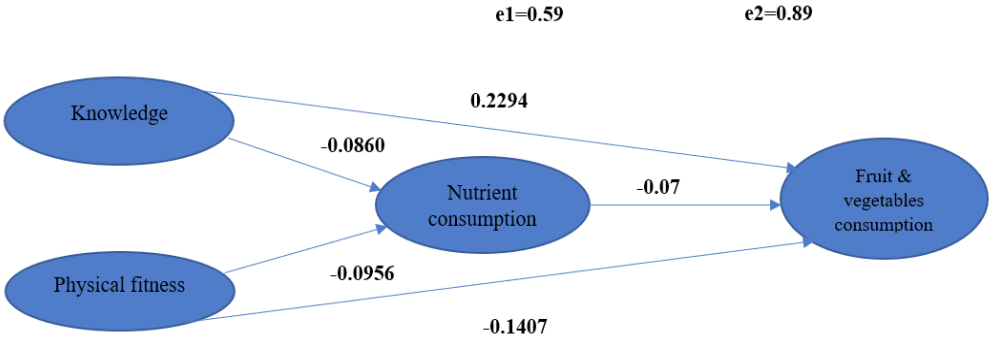

Figure 2. Path analysis diagram (Mataram)

the consumption of nutrients because it must affect the consumption of fruit and vegetables first. Based on Figures 1 and 2, it can be seen that fruit and vegetable consumption as an intermediate variable had no significant relationship with nutrient consumption (p=-0.107 and p=-0.07).

According to Ramsay *et al.* (2014), the consumption of fruit and vegetables only contributes 20% of nutrients, thus there is no significant relationship between fruit and vegetable consumption and nutrient consumption.

CONCLUSION

The average consumption of fruit and vegetables had increased significantly for the subjects in Denpasar and Mataram ($p \leq 0.05$). There was no significant difference between the average physical fitness increase after intervention in Denpasar and Mataram($p>0.05$), while the average score of knowledge increased significantly for the subjects in the two cities ($p \leq 0.05$). Only 12% of fruit and vegetable consumption was directly influenced by knowledge, while the remaining 88% was influenced by other factors. Additionally, physical fitness can affect 10% of fruit and vegetable consumption, with the remaining 90% due to other factors. Integrating nutrition modules in physical education classes may improve fruit and vegetable consumption of the students.

Support is needed from schools, especially teachers, to explain the material on fruit and vegetables in school lessons, as well as providing fruit and vegetables in school canteens so students can gain better knowledge and change their consumption behavior. Moreover, considering that children have activities outside of school, housewives/mothers also play an important role in providing fruit and vegetables that appeal to their children so that they will enjoy consuming fruit and vegetables.

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AUTHOR DISCLOSURES

The authors have no conflict of interest.

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