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the Makassar ethnic population was 28.28% [10]. A high prevalence of MetS is strongly caused by imbalance food intakes. As Hardinsyah reported, the fat and salt intakes of Indonesian people were higher than the WHO recommendation (64.7 g/cap/d and 5.7 g/cap/d, respectively) [11]. In line with the previous finding, a study conducted in Jakarta indicated that high blood pressure was the most cause of MetS in men, while central obesity in women [12]. Most findings in the literature contended that unhealthy lifestyles are associated with the level of knowledge, attitudes, and practices (KAP).

A poor KAP leads individual to consume unhealthy foods which are based on their appetite, and this situation may promote MetS. A study in Sri Lanka population demonstrated the positive association between KAP scores and the risk of cardiovascular diseases (CVD) [13]. Giving nutrition knowledge, attitude, and practice is essential and will result multiple benefits in their lifestyle behavior and subsequently their health [14], [15]. However, there is no current "best" approach to deliver nutrition knowledge, especially for those living in the urban areas which may have high education and other indicators of socioeconomic status.

In our preliminary study, it was shown that balanced nutrition knowledge and practice were associated with the incidence of MetS. Respondents who had a high education level were followed by poor nutrition practices, although they had good knowledge [16]. Some studies used the self-determination theory (SDT) to deliver counseling showed a positive effect on the results [17], [18], [19]. Patrick and Williams defined SDT as "a general theory of human motivation that emphasizes the extent to which behaviors are relatively autonomous (i.e., the extent to which behaviors originate from the self) versus relatively controlled (i.e. the extent to which behaviors are pressured or coerced by intrapsychic or interpersonal forces)" [20]. Principally, there are three domains in basic psychological needs involved in this theory, including autonomy, competence, and relatedness. Therefore, this study was aimed to examine the effects of school-based nutrition education using the SDT approach in the senior secondary high school teacher in Makassar on the change of nutrition knowledge, attitudes, and practices.

## Methodology

### Recruitment and data collection

A pre-post interventional study was carried out among civil servant teachers in Makassar City. There are 2886 numbers of teachers who still active in teaching, but we purposively selected participants from three sub-district with the highest number of

teachers, namely, Biringkanayya, Tamalanrea, and Manggala subdistrict. In these areas, there are 12 schools, but four schools were excluded due to the number of teachers who were willing to participate was small (<6). From included schools (n = 8), a total of 154 teachers meeting the following criteria were invited to participate (Figure 1): Status as civil servant teachers and willing to participate in 3 years of research. Mid-point analysis has been done to only 129 participants and has been published [16]. However, at the end of the study, only 123 teachers could be further analyzed as 31 were dropped out with some reasons, such as sick, declined to participate, pregnant, and traveled overseas. Those who were pregnant and diagnosed with diabetes mellitus and CVD by health professionals were excluded from the study.

### Group allocation and intervention

The group allocation was purposively done by giving autonomy to the schools to decide in which treatment they would like to involve. The way to decide which schools are intervention and control groups was through discussion with the authority of the school (i.e., vice headmaster). All teachers in the schools which chose to participate as intervention group was required to actively participate as they would have four monthly interactive seminars meetings using SDT concept. At the first meeting, all respondents will give the opportunity to assess the results of the examination related to five parameters in MetS. It was expected that all respondents can determine the current health condition and the magnitude of the problems they had since the first meeting. The next three meetings, the information about balanced nutrition guidelines was provided and motivation for respondents to follow the guidelines was emphasized. In the intervention group, there are three means of intervention as follows:

#### Module

We used the modules of balanced nutrition adopted from the Indonesian Ministry of Health [21]. The module distributed in a monthly basis consists of four topics, namely, (1) understanding health problems and consumption of fruit vegetables; (2) physical activity and maintain ideal body weight; (3) intake limitation for sweet, salty, and fatty foods as well as read labels behavior on food packaging; and (4) encourage behavior for having breakfast and drink adequate water. The purpose of this module was to give an intensive exposure of balanced nutrition information to the teachers.

#### Calendar

The calendar contains information on each sheet of the month about practical healthy behaviors

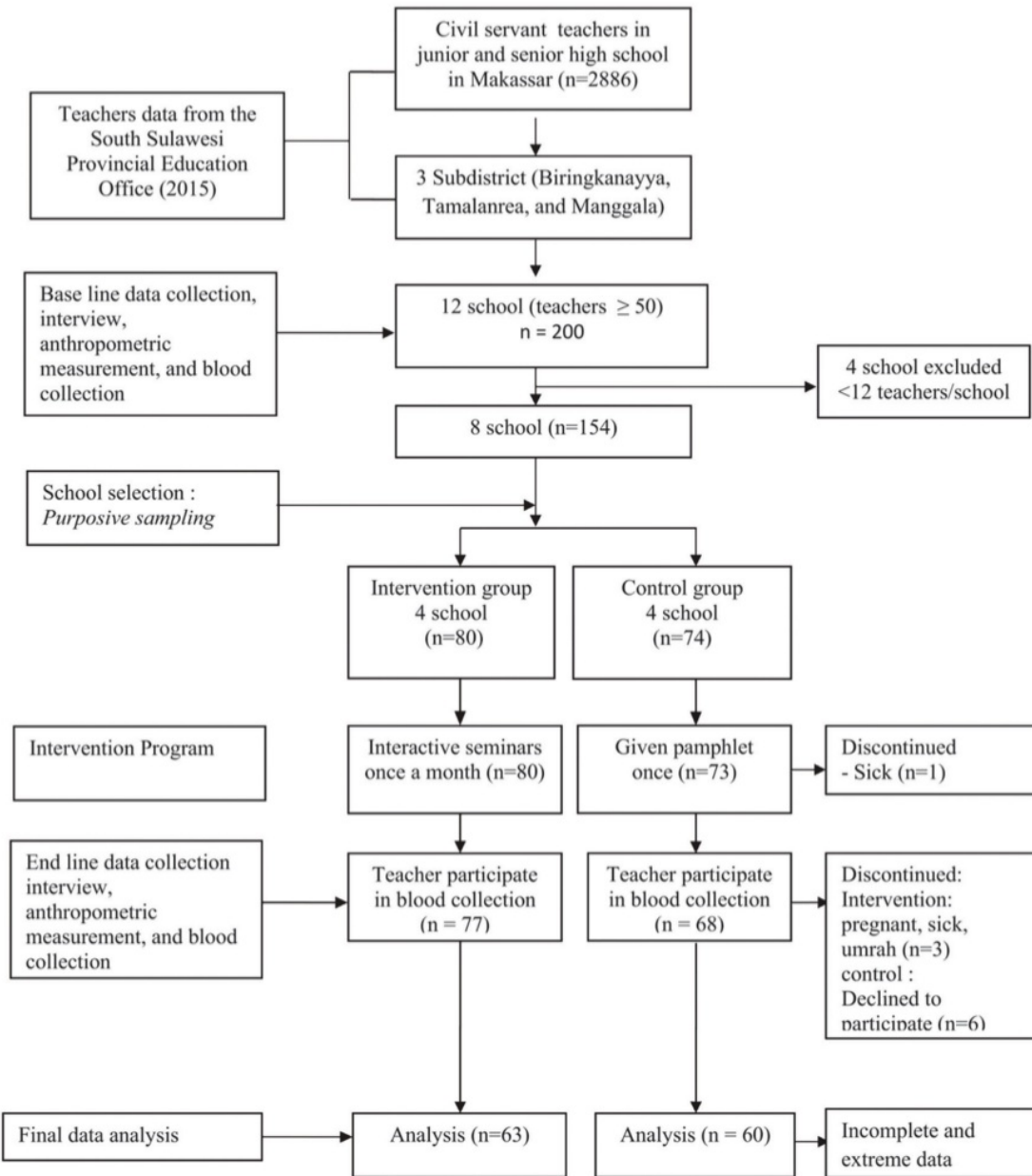


Figure 1: School and respondent recruitment

that could be easily done by the teachers. We develop the intervention in the form of a table calendar with the aim that the calendar can be put on the teacher's desk, and thus will always be seen by them.

#### Poster

The poster emphasizes the information on physical activities. The poster was placed in the strategic

places at schools, such as notification or wall-magazine boards. Hence, teachers were easily exposed.

On the other hand, teachers from four control group schools were exposed with balanced nutrition information through pamphlet which was developed by the Indonesian Ministry of Health [21]. The meeting with the control group only has been conducted once during intervention. In addition to that, a brief presentation about MetS and the ten messages of balanced nutrition were also delivered (Table 1).

**Table 1: The 10 basic messages in balanced nutrition guideline**

Message number	Message text
1	Eat variety of foods
2	Eat plenty of vegetables and fruits
3	Eat high-protein foods (animal or vegetable source)
4	Eat a variety of staple foods
5	Limit consumption of sweet, salty and fatty foods
6	Eat breakfast every day
7	Drink enough safe water
8	Read food labels
9	Wash your hands with soap and running water
10	Perform adequate physical activity and maintain a normal weight

**Data collection**

MetS defined using harmonizing the MetS, the multiple joint agreement world organization international of diabetes federation task force on epidemiology and prevention; national heart, lung, and blood institute; American heart association; world heart federation; international atherosclerosis society; and international association for the study of obesity [8]. Respondents classified as having MetS if they have three or more of five following parameters: abdominal circumference (>90 cm for men and >80 cm for women); HDL levels (<40 mg/dl for male and <50 mg/dl for female); blood pressure (>130/85 mmHg); triglycerides (>150 mg/dl); and fasting blood glucose (levels >100 mg/dl). Based on these indicators, we reported in the previous study the prevalence of Mets among the study population which reached 39.5%, and this number was lower in men than in women (31.4% vs. 68.6%) [16].

Anthropometric measurements were carried out before and after intervention by trained staff. Body height measured using stadiometer required participants remove footwear and hats. Body weight was measured using Camry digital scales and carried out after the respondent removes all the items from his pocket and take off his/her shoes. Abdominal circumference was measured using a measure tape.

**Questionnaire**

The questionnaire used in this study was developed and was validated with two validation processes (Table 2). This questionnaire was used to assess KAP based on balanced nutrition guideline [21]. After the first validation process, few questions indicating inconsistency were reviewed and modified. The second validation process was then conducted and resulted in reliability (Cronbach's alpha) value more than 0.7 for all variables indicating that the questions are acceptable and reliable to be used.

**Table 2: Result of the questionnaire validation process**

No	Variables proxy	Inter-item correlation 1 <sup>st</sup> validation	Reliability (Cronbach's alpha) 1 <sup>st</sup> validation	Inter-item correlation 2 <sup>nd</sup> validation	Reliability (Cronbach's alpha) 2 <sup>nd</sup> validation
1	Knowledge	0.162	0.684	0.255	0.790
2	Attitude	0.094	0.621	0.203	0.737
3	Practice	0.036	0.474	0.204	0.769
4	Autonomic support	0.079	0.619	0.320	0.756

**Processing and analyzing the data**

To ensure the quality of the data, checking the consistency and completeness of the questionnaire and conducted double entry to SPSS before analysis has been done. Data analysis was a Chi-square test for dichotomous data and t-test, as well as Wilcoxon signed-rank test for continuous data. The outcome variable compared to pre- and post-intervention.

**Results**

The baseline characteristic of participants is shown in Table 3. There is no significant difference between intervention and control groups for sex, age, marital status, income, and education level.

Table 4 presents the effect on nutrition education package in both groups. There was a significant improved in knowledge and practice scores of the intervention group (1.0 ± 2.0; p < 0.001 and 2.5 ± 6.8; p < 0.007, respectively), while there were no changes in the control group.

**Table 3: Baseline characteristic of intervention and control group**

Variable	Intervention group (n=63) n (%)	Control group (n=60) n (%)	p value
Sex			
Male	13 (20.6)	13 (21.7)	1.000
Female	50 (79.4)	47 (78.3)	
Age group			
<40 years	6 (9.5)	8 (13.3)	0.703
≥40 years	57 (90.5)	52 (86.7)	
Marital status			
Unmarried/divorce	7 (11.1)	3 (5.0)	0.324
Married	56 (88.9)	57 (95.0)	
Income			
Lower (≤4,300,000)	31 (46.3)	36 (53.7)	0.308
Higher (>4,300,000)	32 (57.1)	24 (42.9)	
Education			
Lower (Senior secondary school and bachelor's degree)	52 (82.5)	43 (71.7)	0.194
Higher (Master and doctoral degree)	11 (17.5)	17 (28.3)	

Figures 2-7 present the changes between pre- and post-intervention for each message in Indonesian Balanced Nutrition Guideline. Figures 2, 4, and 6 illustrate the effect of the intervention on KAP in the intervention group, while Figures 3, 5, and 7 in the control group.

**Table 4: Effect of nutrition education on in knowledge, attitude, and practice change between intervention and control groups**

Variable	Pre-test	Post-test	Diff.	95% CI	p value
Knowledge					
Intervention	18.38±2.03	19.35±1.97	0.97±2.00	-1.47, -0.47	<0.001*
Control	18.43±2.19	18.93±2.06	0.50±2.14	-1.05, 0.05	0.076 <sup>b</sup>
Attitude					
Intervention	39.76±3.59	40.06±2.85	0.30±3.63 <sup>c</sup>	-1.21, 0.61	0.512 <sup>b</sup>
Control	40.70±4.39	42.08±4.09	1.38±6.27	-3.00, 0.24	0.093 <sup>c</sup>
Practice					
Intervention	56.98±7.60	59.40±6.20	2.41±6.81	-4.13, -0.70	0.007 <sup>b</sup>
Control	55.97±6.97	57.82±6.34	1.85±7.56	-3.80, 0.10	0.063 <sup>c</sup>

\*Wilcoxon signed rank test; <sup>b</sup>Paired t-test; <sup>c</sup>Significant (p=0.02) for independent t-test; CI: Confident interval.

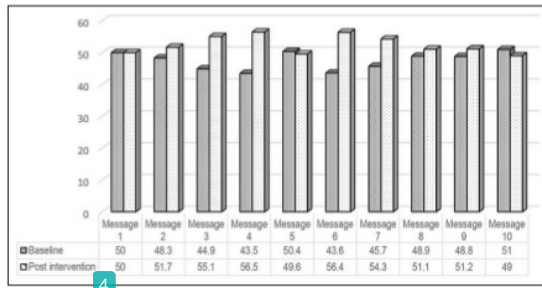


Figure 2: The percentage of teachers in the intervention group answered correctly for the knowledge of the 10 messages in balanced nutrition guidelines

## Discussion

This study examined an emerging theory in motivation, called the SDT, which was embedded in a nutrition education package. The result of the recent study indicated that the education delivered through the SDT-based package to intervention group positively affects the knowledge and practice regarding balanced nutrition, though no effect on attitude. The concept of SDT emphasizes the enhancement of the participant's understanding and motivation and thus, they will have the psychological energy to reach a particular goal in the end [20]. A study has reported that a nutritional

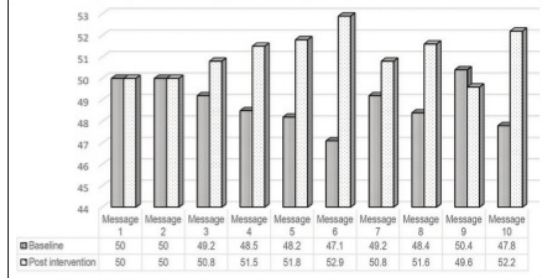


Figure 3: The percentage of teachers in the control group answered correctly for the knowledge of the 10 messages in balanced nutrition guidelines

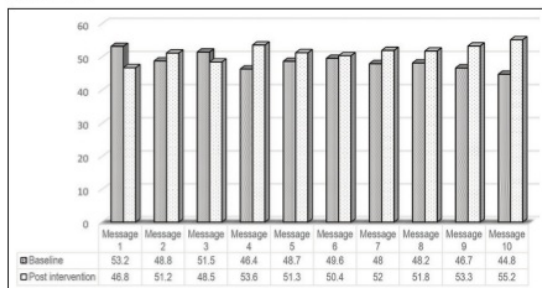


Figure 4: The percentage of teachers in the intervention group answered correctly for the attitude of the 10 messages in balanced nutrition guidelines

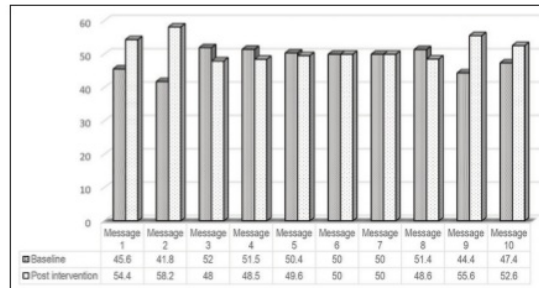


Figure 5: The percentage of teachers in the control group answered correctly for the attitude of the 10 messages in balanced nutrition guidelines

intervention program based on the SDT improved eating motivation and positively associated with the increase of adherence of the Mediterranean diet in response to the intervention [22]. Leblanc *et al.* (2016) suggested that the SDT may encourage people to have a satisfaction of autonomy, competence, and relatedness leading to promote self-determined motivation. Therefore, delivering nutrition education using the concept of SDT will increase the change to improve KAP through increasing an individual's determined motivation.

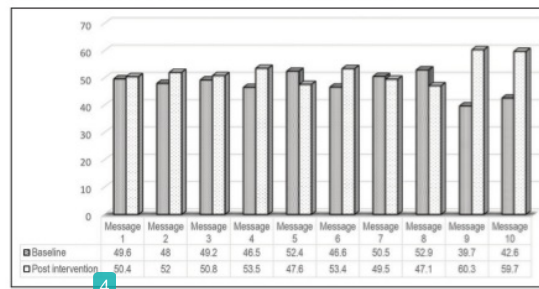


Figure 6: The percentage of teachers in the intervention group answered correctly for the practice of the 10 messages in balanced nutrition guidelines

Education itself has been confirmed can improve behavior-related diseases by mediating the participant's knowledge [23], [24]. A study in Turkey strengthened the evidence that interventions through education can improve knowledge, and thus affecting

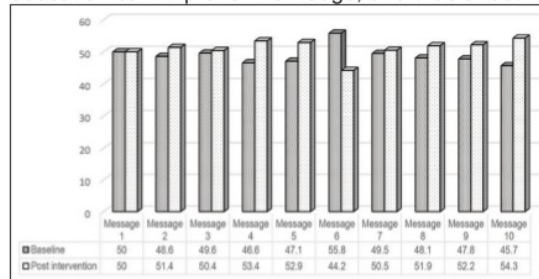


Figure 7: The percentage of teachers in the control group answered correctly for the practice of the 10 messages in balanced nutrition guidelines

someone's behavior [25]. In this study, KAP refers to the 10 principal messages in Indonesian dietary

35 delines (Table 1). The percentage of teachers in the intervention and control groups who answered correctly for the KAP regarding the 10 messages in balanced nutrition guidelines was shown in Figures 2-7.

10 The results of the study did not show a significant change in attitude for both groups. It may be due to the fact that all intervention packages included the one given to the control group, do not emphasize the aspect of attitude. In addition, the baseline result showed that the majority of teachers in both groups already have a good attitude, and therefore, it can be difficult to change. It is only reluctant attitudes that can rapidly be changed. A better understanding of particular information underlies the change of attitudes to be more positive, thus educating people is important. If people have resisting attitudes toward health promotion, they are likely to have unhealthy lifestyles compared to others [26]. Conversely, the more people have moderate knowledge and good attitudes, the more likely good practices [27]. In our opinion, good attitudes can be significant in improving a healthy lifestyle when it is supported with adequate knowledge.

The main goal of educating people with health and nutrition information is the modification of their behavior to be better. This study shows that the practice score increased in both groups, though only in the intervention group was significant. It is probably due to the means of education method given to the intervention group were more effective to motivate teachers. Modules, calendars, and posters compiled balanced nutrition practices motivating teachers to do healthy practices. A study reports that education tools can improve behavior, increasing physical activity, and consumption of vegetables as well as fruits in Australian adults [17]. Intervention given to teachers may promote "internalization" of the materials (balanced nutrition), thus a person may do the activities related to that information provided. Internalization of balanced nutrition information may be partly due to 3e frequency of exposure to the material which is higher than those received by the control group. Moreover, the level of education may also affect behavior mediating by knowledge. A study indicated knowledge declining with lower education [28]. Thus, increased practice in the control group may be partially affected by their education. In addition, parents' roles, gender, and lack of control over are the other factors underlying unhealthy behavior [28], [29], [30].

Despite the fact that the application of the SDT concept has not improved attitudes, this concept is still applicable to fostering self-determined motivation by improving knowledge of balanced nutrition. As a reaction to this knowledge, people are encouraged to implement balanced nutrition practices. Therefore, it is possible to implement the SDT concept during the

implementation of nutrition programs in Indonesia. For example, the compliance of pregnant women to the consumption of iron supplements can be significantly increased by increasing their confidence and motivation. However, further study needs to prove the implementation stage of the SDT concept in the real-setting nutrition program, especially in the population with low-education level.

There were some limitations acknowledged in this study. First, the distribution of this study did not use random allocation. However, the nature of the study made a randomized controlled trial done as it is a school authorization. Second, gender domination (female) may also affect the result of the study. However, the composition of female participants between intervention and control group may reduce the result biases caused by gender.

## Conclusions

In summary, nutrition education using the SDT concept may improve knowledge, emphasizing motivation and thus corroborating practices of balanced nutrition. Although attitude did not significantly change in both groups, it still probably has a contribution to practices. It is suggested to the government that the media of nutrition education for improving a healthy lifestyle may adopt the SDT, especially when targeting a specific population.

## Acknowledgments

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## 5 Competing Interest

The authors declare no conflicts of interest. The funder institution had role in the design of the study; in the collection, analyses or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

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