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Original Research Article

Correlation between saturated fatty acid intake and superoxide dismutase activities with telomere length in Minangkabau ethnic men

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ABSTRACT

Background: Non-communicable diseases (NCD) are the leading cause of death globally today. In West Sumatra there has been an increase in NCD which exceeds the national average percentage. Telomere shortening is associated with occurrence of NCD. Shortening of telomeres is influenced by diet. The purpose of this study was to examine the relationship between Saturated Fatty Acid (SAFA) intake and Superoxide Dismutase (SOD) activity with the telomere length of Minangkabau ethnic men.
Methods: This study was a cross sectional study. The sample of this study were 69 civil servants of Minangkabau male at district office in the Padang City, aged 40-50 years and according to the inclusion and exclusion criteria. Data on SAFA intake was obtained using Semi Quantitative Food Frequency Questionnaire (SQFFQ), SOD activity was measured using the Calorimetric method and telomere length was measured using Real Time Polymerase Chain Reaction (RT-PCR) by O'Challaghan and Fennech method. Data analysis was performed using Pearson correlation test with significance level $p < 0.05$.
Results: The results showed an average SAFA intake 10.47±3.46% calories, SOD activity 5.93±0.81units/ml and telomere length 468.94±199.25bp. Correlation test between telomere length with SAFA intake showed ($p=0.338$), and the correlation test between SOD activity and telomere length showed ($p=0.01$).
Conclusions: From this study it was concluded that there was no correlation between SAFA intake and telomere length and there was a significant positive correlation between SOD activity and the telomere length of Minangkabau ethnic men.

Keywords: Minangkabau ethnic men, Telomere, SAFA, SOD

INTRODUCTION

Non communicable diseases (NCD) are the main cause of death globally and nationally today.[1] Results of Basic Health Research (2007) showed that in Indonesia, communicable diseases caused 28.1% of deaths while the Non-communicable diseases (NCD) caused the majority death, 59.5%.[2] NCDs also increased from 61.39% in 2009 to 65.9% in 2010 and exceeded the national average percentage in West Sumatra.[1] Telomere shortening is associated with the occurrence of NCDs.[3] Telomeres are non-coding DNA sequences at the ends of the chromosomes and shorten with each cell division.[4] The acceleration of telomere shortening causes faster aging and an increased risk of suffering from NCD.[5,6] Accumulation of telomere shortening, results in critical limit of telomere length, thus subsequent cell division cannot take place. Cells that cannot divide further will

experience aging which continue to apoptosis. Cells that experience aging will accumulate in tissues/organs and can potentially disrupt normal tissue functions and structures. The more cells that undergo apoptosis, further decline in organ function occur.[7]

Lifestyle factors such as dietary patterns play an important role in the occurrence of telomere shortening.[8] The proportion and composition of food intake is related to telomere length, the aging process and the risk of some chronic diseases.[8,9] Results of study by Song et al, stated that people who consume high amounts of saturated fatty acids have shorter telomere lengths than people who consume low amounts of saturated fatty acids.[10] Food products containing high SAFA can promote release of Reactive Oxygen Species (ROS) and pro-inflammatory cytokines, thus increasing the level of oxidative stress in the body. High oxidative stress level which occur for a long time will accelerate the shortening of telomeres and increase the risk of NCD.[9,11] The Minangkabau ethnic community has high saturated fat diet. The percentage saturated fat consumption in Minangkabau ethnic is around 20.7%.[12] Eating habits that consume saturated fatty acids that exceed the standard requirements for long term can increase the formation of ROS in various tissues, increasing oxidative stress, which in turn accelerate the shortening of telomeres as high risk factors for NCD.[10,13]

Telomere shortening is also determined by the balance of ROS and antioxidants in the body.[6] Antioxidants are protective agents that deactivate ROS so that they can significantly prevent oxidative stress. The antioxidant's ability to modulate oxidative stress plays a role in determining the occurrence of telomere shortening.[6,14] SOD is the main enzymatic endogenous antioxidant and acts as the first defence against ROS. SOD has the ability to eliminate the toxic effects of superoxide anion (O_2^-).[15,16] Research by Wang showed that groups which experienced increased oxidative stress and low SOD activity had shorter telomeres.[17] The study aimed to examine the correlation between SAFA and SOD with the telomere length of Minangkabau ethnic men.

METHODS

This research was an analytical observational research. The design used was a cross sectional study conducted in 11 sub-districts of Padang City and the Biomedical Laboratory of the Faculty of Medicine. The study was conducted from February 2017 to August 2017. The population in this study were Minangkabau civil servants (PNS) at Sub-district Office in Padang City. The samples taken were 69 Minangkabau male civil servants at district office in Padang City according to the inclusion and exclusion criteria. The sample was selected by simple random sampling. The inclusion criteria for this study were those who willed to be respondents and aged 40-50 years, while the exclusion criteria were those who were not present during the study and did not suffer from cancer.

Data of fat intake was obtained using Semi Quantitative Food Frequency Questionnaire (SQFFQ) by interview and the results were stated in % of total calories. SOD activity was measured using the Calorimetric method and stated in units/ml. Telomere length was measured by Real Time Polymerase Chain Reaction (RT PCR) tool and analysis according to the O'Challaghan and French (2011) method, with results stated in base pairs (bp) Data analysis was performed using Pearson correlation test with significance level $p<0.05$.

RESULTS

Data on fat intake and SOD activity obtained were analyzed by Pearson correlation test and linear regression.

Table 1: The mean of telomere length, SAFA intake and sod activity of Minangkabau ethnic men.

Variables	N	Mean±SD	Min.	Max.
Telomere Length (bp)	69	468.94±199.25	202.00	961.00
SAFA (% calories)	69	10.47±3.46	3.96	25.95
SOD (unit/ml)	69	5.93±0.81	3.42	7.06

Table 1 showed the mean telomere length of the Minangkabau ethnic men was 468.94±199.25 base pair (bp) with highest telomere length was 202 bp and lowest telomere length was 961 bp. The mean SAFA intake of the Minangkabau ethnic men was 10.47±3.46% calories with minimum SAFA intake was 25.95% calories and minimum SAFA intake was 25.95% calories. The mean SOD activity of the Minangkabau ethnic men was 5.93±0.81 units/ml with highest SOD activity was 7.06units/ml and lowest SOD activity was 3.42units/ml.

Figure 1 showed no significant correlation between SAFA intake and telomere length Minangkabau ethnic men ($p = 0.338$). $R^2 = 0.014$ shows that the effect of SAFA intake on telomere length is 1.4% which meant that 1,4 % of the telomere length is determined by SAFA intake. The rest is caused by other factors.

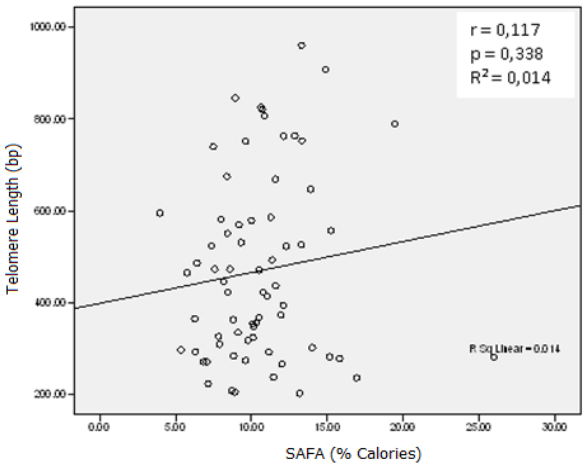

Figure 1: Correlation between SAFA and telomere length of Minangkabau ethnic men.

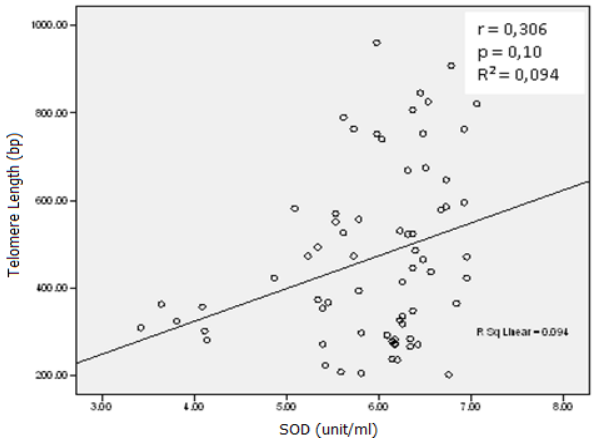

Figure 2: Correlation between SOD and telomere length of Minangkabau ethnic men.

Figure 2 showed a significant correlation between SOD activity and telomere length. Correlation of SOD activity with telomere length had a low correlation level and positive pattern/direction which meant that the higher the SOD activity, the longer the telomere length ($p = 0.01$, $r = 0.306$). $R^2 = 0.094$ showed that the effect of SOD on telomere length was 9.4%. Linear regression test results showed Telomere length = 23.431±75,079 (SOD activity). Telomere shortening was reduced by 75,079 bp with each increases of SOD activity per unit/ml.

DISCUSSION

This study showed the SAFA intake of Minangkabau ethnic men aged 40-50 years, of 10.47%. The recommended SAFA intake by the National Cholesterol Education Program (NCEP) and American Heart Association (AHA) is <10%.[18] The results of this study showed saturated fat intake of 10.47%, higher than recommended value of 0.47%. The results of this study showed that the average SOD enzyme activity was 5.93U/ml. The study by Nojima M et al, 2009 in Japanese people aged 40-79 years showed an average SOD activity of 3.21U/ml in men and 3.52U/ml in women. The method of measuring SOD activity had not been standardized so it was difficult to compare results in various studies.[19] Differences in SOD activity could be influenced by several factors such as genes, age, gender and lifestyle.[19]

Increased SAFA intake can increase the production of pro-inflammatory cytokines (IL-6 and TNFα) and oxidative stress in the body so that telomere shortening occurs. SAFA intake of 10.47% is still at the recommended limit of NCEP and AHA, which does not cause increased oxidative stress and is suspected had no significant correlation with telomere length. In addition, respondents with SAFA intake >10%, around 63.9% of them, had SOD activity above average (>5.93u/ml). SOD activity is able to eliminate/neutralize superoxide anion radicals (O_2^-) produced by increasing SAFA intake. This also allegedly resulted in SAFA intake not having a significant relationship with telomere length. The results of this study were different from those of Kark D (2012) and the study of Tiainen A (2012) which stated that there was a significant correlation between SAFA intake and telomere length ($p = 0.007$ and $p = 0.01$). The difference in results with this study was seen from the difference in SAFA intake, where SAFA intake in the Kark D study (2012) was 11.3% and SAFA intake in the study of Tiainen A (2012) was 13.3%. SAFA intake of study by Kark D (2012) and Tiainen A (2012) was higher when compared to this study (10.47%), which could result in different finding.[11,20]

In this study, a significant correlation was found between SOD activity and the telomere length of Minangkabau ethnic men ($p = 0.01$, $r = 0.306$). The correlation between SOD activity and telomere length has a positive pattern/direction. The test results also showed that 9.4% of telomere length were determined by SOD activity and regression test predictions stating that each increase of SOD activity per 1u/ml of would reduce telomere shortening by 75.079 base pair (bp). This study was in line with the research of Zhou M et al, in the Chinese population showing the relationship between SOD activity and telomere length ($p = 0.001$).[9] Endogenous antioxidant activity protects telomere length.[8] SOD is one of the most critical antioxidant enzyme that can prevent oxidative stress and minimize the damage which occurred in cells so that they can preserve telomere length.[15] Wang's experimental study (2014) showed that a group of male rats with low SOD activity had shorter telomeres.[17] There was a significant positive correlation between SOD activity and telomere length of Minangkabau ethnic men, so some efforts to increase SOD activity can be done as an effort to prevent telomere shortening.

Some efforts that can be made to increase SOD activity include the adequacy of zinc (Zn) and copper (Cu) mineral intake which act as cofactors so that SOD enzymes function properly. Besides that, doing moderate intensity exercise on a regular and long-term basis and

applying Mediterranean diet pattern which is high in vegetables, fruits, cereals, fish and low meat and daily products can increase the antioxidant activity of SOD.[8,21,22] Research by Chen J, stated that poly unsaturated fatty acids (n-3 PUFAs) had a role in increasing antioxidant activity. Poly unsaturated fatty acids (n-3 PUFA) contained in fish oil can increase cardiac SOD activity by around 19%-58% in rats which experience aging ($P<0.05$).[23]

CONCLUSION

There was no correlation between SAFA intake and telomere length and there was a positive correlation between SOD activity and telomere length of Minangkabau ethnic men. Telomere shortening will be reduced by 75.079 bp with each increases in SOD activity per unit/ml.

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REFERENCES

1. Indonesia Ministry of Health. Overview of Non-Communicable Diseases in Indonesia 2009-2010: Center for Data and Information, 2012. Available at: www.depkes.go.id/download.php?file=download/pusdatin/buletin/buletin-ptm.pdf. Accessed March 3 2017.
2. Indonesia Ministry of Health. RISKESDAS: Basic Health Research, 2013. Available at: http://labmandat.litbang.depkes.go.id/riset-badan-litbangkes/menu-riskesnas/menu-riskesdas/374-rkd-2013. Accessed March 2, 2017
3. Nettleton JA, Roux AD, Jenny NS, Fitzpatrick AL, David RJ Jr. Dietary patterns, food groups and telomere length in the multi-ethnic study of atherosclerosis (MESA). Am J Clin Nutr. 2008;88(5):1405-12.
4. Grahame TJ, Schlesinger RB. Oxidative stress-induced telomeric erosion as a mechanism underlying air bone particulate matter-related cardiovascular disease. Particle and Fiber Toxicology. 2012;9(21):1-19.
5. J-Y, Jun NR, Yoon D, Shin C, Baik I. Association Between Dietary Patterns in The Remote Past and Telomere Length. Euro J Clin Nutri. 2015;69:1048-52.
6. QunXu, Parks CG, DeRoo LA, Cawthon RM, Sandler DP, Chen H. Multivitamin use and telomere length in women. Am J Clin Nutr. 2009;89:1-7.
7. Grahame TJ, Schlesinger RB. Oxidative stress-induced telomeric erosion as a mechanism underlying air bone particulate matter-related cardiovascular disease. Particle and Fiber Toxicol. 2012;9(21):1-19.
8. Boccardi V, Esposito A, Rizzo MR, Marfella R, Barbieri M, Paolisso G. Mediterranean diet, telomere maintenance and health status among elderly. PloS one. 2013 Apr 30;8(4):e62781.
9. Zhou M, Zhu L, Cui X, Feng L, Zhao X, He S, et al. Influence of diet on leukocyte telomere length, makers of inflammation and oxidative stress in individuals with varied glucose tolerance: a Chinese population study. Nutrition J. 2016;15(39):1-10.
10. Song Y, You NC, Song Y, Kang MK, Hou L, Wallace R, et al. Intake of small-to-medium-chain saturated fatty acids is associated with peripheral leukocyte telomere length in postmenopausal women-3. J Nutri. 2013 Apr 24;143(6):907-14.
11. Tiainen A-MK, Mannisto S, Blomstedt PA, Moltchanova E, Perata M-M, Kaartinen NE, et al. Leukocyte telomere length and its relation to food and nutrient intake in elderly population. Euro J Clin Nutri. 2012;66:1290-9.
12. Hatma RD, Lukito W, Rumawas YSP. Fatty acids intake among diverse ethnic group in Indonesia. Med J Indonesia. 2011;14(4):242-7.
13. Eszy M, Sastri S, Masri M. Effect of Giving High Palm Oil Diets on Malondialdehyde Levels in Wistar Rat Blood. Andalas Heal J. 2014;3(3):409-14.
14. Sayuti K, Yenrina R. Understanding antioxidants and their benefits. In: Antioxidants, Natural and Synthetic. Padang: Andalas University Press; 2015:7-14.
15. Michael JVR, Hekimi S. Superoxide dismutase is dispensable for normal animal lifespan. PNAS. 2012;109(15):5785-90.
16. Muchtadi D. Body's defense system against free radicals In: Nutrition for Anti-Aging. Bandung: Alfabeta Publisher; 2009:133-158.
17. Wang Y, Yang Y, Ma L, Zhao Y, Bai Z, Ge RL. Telomeres are elongated in rats exposed to moderate altitude. J Physiological Anthropol. 2014 Dec;33(1):19.
18. Hayes KC. Dietary fat and heart health: in search of the ideal fat. Asia Pacific J Clin Nutri. 2002;11:S394-S400.
19. Nojima M, Sakauchi F, Mori M, Tamakoshi A, Ito Y, Watanabe Y, et al. Relationship of serum superoxide dismutase activity and lifestyle in healthy Japanese adults. Asian Pacific J Cancer Prevention. 2009;10:37-40.
20. Kark JD, Goldberger N, Kimura M, Sinnreich R, Aviv A. Energy intake and leukocyte telomere length in young adults. Ame J Clin Nutri. 2012 Jan 11;95(2):479-87.

21. Fukai T, Folz RJ, Landmesser Ulf, Harrison DG. Extracellular superoxide dismutase and cardiovascular disease. Cardiovas Res. 2011;55:239-49.
22. Shin Y, Lee JH, Song W, Jun TW. Exercise training improves the antioxidant enzyme activity with no changes of telomere length. Research Institute of Sport Science, Seoul University Korea. 2008;129:254-60.
23. Chen J, Wei Y, Chen X, Jiao J, Zhang Y. Polyunsaturated fatty acids ameliorate aging via redox-telomere-antioncogene axis. Oncotarget. 2017;8(5):7301-14.

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