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Literature Review

Fiber consumption effect on non-communicable disease: How big is the impact?

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ABSTRACT

Non-communicable diseases have effects on the quality of human resources because, in addition to causes of death and morbidity, they also reduce productivity. Fiber intake was allegedly affecting the incidence of non-communicable diseases. The purpose of this literature review is to look at the link between fiber intake and the incidence of non-communicable diseases and the effect of fiber supplements to treat non-communicable diseases. Several literature indicate that fiber intake is associated with cardiovascular disease, diabetes mellitus, cancer, and obesity. Research also shows fiber supplementation can improve metabolic profiles, blood sugar, insulin resistance in cardiovascular and diabetes mellitus patients. Fiber supplementation also reduces the risk of breast cancer. Fiber intake is related to the incidence of non-communicable diseases and can overcome some non-communicable diseases



INTRODUCTION

Indonesia's national development goals are inseparable from the development of human resources, therefore, improving the quality of human resources is part of the development process. While the impact of non-communicable diseases on the resilience of human resource is tremendous because it causes death, morbidity, and decrease in productivity. In the 2015-2019 National Medium Term Development Plan (Rencana Pembangunan Jangka Menengah Nasional or RPJMN) it was stated that the reduction target of the prevalence of high blood pressure was 25.8% in the initial year (2015) to 23.4% (2019). The prevalence of overweight and obesity in 18-year-old residents is also sought to remain stable as the initial incidence is 28.9% (Bappenas, 2015).

Non-communicable diseases are currently the government's primary concern because besides being the leading cause of death, the prevalence tends to increase. Based on the results of the 2018 Riskesdas, the incidence of hypertension as much as 34.1% increased from the 2013 Riskesdas, which was 25.8%, while the prevalence of Diabetes Mellitus was 8.5%, higher than the previous 6.9% (Kemenkes, 2018).

The existence of the epidemiological transition from infectious diseases to non-communicable diseases is estimated due to socio-economic, environment, and population structure changes. People have adopted unhealthy lifestyles, such as smoking, lack of physical activity, harmful eating patterns, and alcohol consumption, which are the risk of non-communicable diseases (Bonita, 2013).

In terms of diet, it is estimated that there are risk factors for non-communicable diseases, especially fiber intake. Based on the results of the 2013 Riskesdas, 93.5% of Indonesian fruit and vegetable consumption is still

lacking. Therefore, it is assumed that fiber diets are also lower than WHO recommendations, 25-35 grams per day.

LITERATURE REVIEW

Fiber Definition and Composition

Dietary fiber is a part of plants including carbohydrates, which cannot be digested and absorbed in the small intestine, either entirely or partially fermented in the large intestine of humans. They include polysaccharides, oligosaccharides, lignin, and related plant substances (Prosky, 2001). Intake of dietary fiber has been reported to be beneficial in reducing serum cholesterol and blood pressure. Therefore, it is believed that a lack of dietary fiber can contribute to the epidemic of cardiovascular disease.

Different compositions of various fibers explain the diversity of functions, including water retention capacity, absorption properties (bile salt binding capacity, glucose, and fat absorption), tendency to form gels, viscosity, fermentability and the ability to modify the composition of intestinal microbiota. These components can reduce metabolism and change certain CHD risk factors, improve CHD prognosis, and reduce the probability of cardiovascular events (Bocanegra, 2009). Generally, Dietary Fiber (DF) is grouped based on solubility in water, water-soluble dietary fiber (pectin, pectins, gums, and mucilages and storage polysaccharides) and dietary fiber insoluble in water (cellulose, hemicellulose and lignin) (Papathanasopoulos, 2010). One source of potentially rich dietary fiber is whole grain products. Intake of whole grains is positively related to health.

This article is a review of the results of research studies and meta-analyzes that assessed the relationship between fiber and non-communicable diseases that are widely published. It also discusses about cardiovascular



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disease, diabetes mellitus, and cancer, or biomarkers that are considered to contribute to the disease such as lipid profiles (TG, TC, LDL-C, HDL-C), insulin resistance, and blood pressure.

Fiber and Cardiovascular Disease

Most of the studies showed that fiber intake affected the occurrence of cardiovascular disease. Research from four meta-analyses of the effect of fiber diet and the risk of cardiovascular disease has been found by Rae (2017), Wei et al. (2017), Kim and Je (2015) and Wu et al. (2014). Mc. Rae (2017) found a significant reduction in cardiovascular disease mortality, as well as the incidence of cardiovascular disease, coronary heart disease, and strokes on a high-fiber diet. Wei et al. (2017) showed there was a curvilinear relationship found between fiber consumption and the prevalence of Metabolic Syndrome (MetS). Compared with non-fiber intake, OR Metabolic Syndrome at all levels of fiber intake were 0.85 for the intake of 10 g/d and 0.73 for the intake of 40 g/d.

Wu et al. (2015) proved that fiber diets based on fiber subtypes (cereals, fruit, and vegetable fiber) were also shown to reduce the risk of coronary events, where the RR of all coronary events was 0.93 ($p = 0.001$) and 0.83 ($p = 0.001$) for mortality. According to Kim and Je (2015), the RR (Relative Risk) of CVD and CHD were 0.77 and 0.76, respectively, for the highest versus lowest dietary fiber category.

Other studies that show similar results to those of the meta-analysis were researched by Park et al. (2011), Tayyem et al. (2017) and Xu et al. (2016). Threapleton et al. (2013) have different findings, which is fiber intake is not associated with fatal CHD, stroke, or cardiovascular disease risk (CVD). However, it shows the possibility of protection of cereal fiber at risk of fatal stroke in women with excess weight. Xu

et al. (2016) said that the ratio of protein and fiber intake significantly affected the incidence of CVD, where the protein-fiber ratio was 1.15 times higher than the average, would increase Hazard Ratio. Dietary fiber is not significantly associated with CVD events.

Fiber and Diabetes Mellitus

Effect of fiber intake on the risk of diabetes mellitus is estimated through intermediate outcomes/biomarkers (e.g., blood sugar). Research by Fuji et al. (2013) found a high-fiber diet reduced cardiovascular risk in patients with diabetes mellitus. A high-fiber diet also has a negative relation with blood sugar and metabolic syndrome (Cholesterol levels, Glucose, HOMA-IR, blood pressure). Goff et al. (2017) also found a high-fiber diet associated with a decrease in blood sugar, thus decreasing the risk of Diabetes Mellitus Type 2 (DMT2).

Fiber and Cancer

The effect of fiber intake on cancer has been shown in several meta-analysis studies including a meta-analysis by Dong et al. (2011), where the RR of breast cancer between the highest dietary fiber intake compared with the lowest was $p = 0.444$. A significant result is shown by Aune et al. (2011) in a meta-analysis study where RR for the highest versus lowest intake at risk of breast cancer was 0.93 ($p = 0.00$). Based on a meta-analysis by Kim and Je (2015), the highest dietary fiber intake shown the risk of death of all types of cancer was 0.86 times lower than the lowest intake.

Another result of this study is the effect of fiber on esophagus cancer, where Coleman et al. (2013) proved that there was a significant relationship between the highest fiber intake with esophagus cancer. Similar results showed that regular fiber intake reduced the risk of esophagus cancer (Tang et al. (2013). Zhang



Table 1. 1 Research Summary on The Effects of Fiber on Non-Communicable Diseases

NO	SOURCE	DESIGN	SAMPLE	VARIABLE	OUTCOME	CONCLUSION
1.	McRae (2017)	Meta-Analysis	Adults	Fiber diet	Cardiovascular diseases	There is a statistically significant decrease in (RR) cardiovascular disease mortality, as well as the incidence of cardiovascular disease, coronary heart disease and stroke in those with a high-fiber diet
2.	Wei <i>et al.</i> (2017)	Meta-Analysis	Adults (n=28241)	Fiber diet Coronary artery disease risk and Stroke	Metabolic syndrome	There was a curvilinear relationship found between fiber consumption and the prevalence of Metabolic Syndrome.
3.	Wu <i>et al.</i> (2014)	Meta-Analysis	Adults (n=672408)	Fiber diet by type Coronary artery disease risk and Stroke	Risk of coronary events and CHD mortality	There is a significant relationship between fiber intake and CHD incidence and mortality (p <0.001)
4.	Kim and Je (2015) Meta-Analysis Study - Diet	Meta-Analysis	-	Fiber diet	CVD and the risk of death due to all types of cancer	Dietary fiber reduces the RR of CVD, CHD, and the risk of death from all types
5.	Park, <i>et al.</i> (2011)	Cohort Prospective	CHD patient (n = 219.123 males and 168.999 females)	Food fiber	Risk of death due to CHD	Dietary fiber intake reduce the risk of death from CHD
6.	Tayyem <i>et al.</i> (2017)	Case-Control	CHD patient	Fiber dietary pattern	CHD Risk	Fiber high diets significantly reduce the odds of CHD (OR = 0.55, 95% CI = 0.27 - 0.92)
7.	Xu <i>et al.</i> (2016)	Prospective Cohort	Male adults with CKD (Chronic Kidney Disease) (n=390)	Protein diet, fiber diet, and the ratio of protein and fiber diets	CVD Event	Protein intake ratio - fiber associated with CVD incidence. Food fiber only is not significantly associated with CVD events



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8.	Threapleton <i>et al.</i> (2013)	Cohort Prospective	CVD patient (n =31,036 women)	Fiber diet	CHD dan Stroke risk	Total dietary fiber and fiber from different food sources not related to fatal CHD, stroke or CVD risk
9.	Fuji <i>et al.</i> (2013)	Cross-Sectional	Diabetes patient (n=4399)	Fiber diet	Cholesterol levels, Glucose, HOMA-IR, blood pressure (metabolic syndrome) and cardiovascular risk factors	High-fiber diets reduce cardiovascular risk in people with diabetes mellitus, are negatively related to blood sugar levels and metabolic syndrome.
10.	Goff <i>et al.</i> (2017)	Cross-Sectional	Adults	Fiber diet	Glucose levels	A high-fiber intake is associated with a decrease in blood sugar so that reducing the risk of DMT2
10.	Dong <i>et al.</i> (2011)	Prospective Cohort	Woman (n= 712,195)	Fiber diet	Breast cancer	There was a decrease in RR breast cancer between the highest compared to the lowest dietary fiber intake
11.	Aune <i>et al.</i> (2011)	Meta-Analysis	-	Fiber intake	Breast cancer	RR for the highest versus the lowest consumption was 0.93 (95% CI 0.89–0.98, R ² = 0%) for dietary fiber
12.	Coleman <i>et al.</i> (2013)	Meta-Analysis	-	Fiber diet Gastric cancer	Esophagus cancer	There was a significant relationship between fiber intake and the incidence of esophagus cancer
13.	Tang <i>et al.</i> (2013)	Case-Control	Oesophageal cancer patients (n = 359)	Fiber diet	Oesophageal cancer risk	Higher fiber intake decreases the risk of oesophageal cancer (p = 0.004)
14.	Zhang <i>et al.</i> (2013)	Case-Control	-	Fiber diet	Gastric cancer	The odds ratio of gastric cancer is lower on a high fiber intake diet compared to low fiber intake



High Fiber Supplements And Diets To Overcome Non-communicable Diseases

The following studies have shown the influence of supplementation and fiber intake to treat these diseases. Alba et al. (2016) reported increase soluble fiber from Partially Hydrolysed Guar Gum (PHGG) on a normal diet towards type 2 diabetes patients and MetS improved cardiovascular and metabolic profiles by reducing WC, HbA1c, UAE and trans-FA. Routine increase and consumption of Dietary Fiber (DF) soluble causes a significant improvement in blood glucose levels, insulin resistance and metabolic profile, without improving the secretory function of Islets of Langerhans, during the short-term intervention period in DMT2 patients (Chen et al., 2016)

According to Post et al. (2012), interventions involving fiber supplementation for patients with type 2 diabetes mellitus can reduce fasting blood glucose and HbA1c. Meta-analysis studies proved increasing fiber intake also increased glycemic control, suggesting this should be considered to be a treatment of patients with type 2 diabetes (Silva et al., 2013).

For cancer, a dose-response analysis showed that each 10-g/d increase in dietary fiber intake was associated with a significant 7% reduction in breast cancer risk (Dong et al. (2015). A meta-analysis study by Kim and Je (2015) showed that RR for a 10 g/day increase in dietary fiber was 0.91 for CVD, 0,89 for CHD, and 0.94 for all types of cancer.

CONCLUSION

Fiber intake is related to the incidence of non-communicable and can overcome some non-communicable diseases, especially cardiovascular diseases, diabetes mellitus, and cancer.

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