Poor Physical Function as a Risk Factor for Non-Communicable Diseases in Indonesia: A Retrospective Cohort Study

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ABSTRAK

Latar belakang: *belum dapat dipastikan bahwa seseorang yang memiliki fungsi fisik buruk berisiko mengalami Penyakit Tidak Menular (PTM). Tujuan penelitian ini untuk menentukan apakah fungsi fisik buruk berisiko mengalami PTM.* ***Metode:*** *desain kohor retrospektif tetap diterapkan dalam penelitian ini dengan menggunakan data Indonesia Family Life Survey (IFLS) pada 2007 dan 2014. Sebanyak 6.863 responden yang tidak didiagnosis PTM oleh tenaga medis pada 2007 berhasil dilacak. Setelah dikendalikan oleh kovariat, hubungan antara terkena PTM dan kondisi fungsi fisik buruk diukur dengan Adjusted Risk Ratio (ARR) dan Population Attributable Risk (PAR).* ***Hasil:*** *responden yang memiliki fungsi fisik yang buruk secara signifikan berisiko didiagnosis stroke (ARR: 6,9; 95% CI: 4,3-10,9), diabetes (ARR: 3,1; 95% CI: 2,4-4,1) dan penyakit jantung (ARR: 3.2; 95% CI: 2,4-4,5). Skor PAR responden yang menderita diabetes yaitu 0,006, berarti 0,6% kasus diabetes dapat dicegah jika orang memiliki kondisi fungsi fisik yang baik.* ***Kesimpulan:*** *fungsi fisik yang buruk dapat dinilai untuk mengidentifikasi risiko terkena diabetes, penyakit jantung, dan stroke. Tenaga kesehatan sebaiknya menyediakan program pendidikan kesehatan untuk menjaga kesehatan dan kemampuan fisik pasien.*

Kata kunci: *fungsi fisik buruk, penyakit tidak menular, risk ratio, population atributable risk.*

ABSTRACT

Background: *it cannot be ascertained whether an individual with poor physical function is at an increased risk of Non-Communicable Diseases (NCDs), thus the aim of this study is to examine this potential relationship.* ***Methods:*** *in this study, a fixed retrospective cohort design has been conducted by using data from the Indonesia Family Life Survey (IFLS) in 2007 and 2014. A total of 6,863 respondents who were not diagnosed with NCD by medical personnel in 2007 were successfully traced. After being controlled for covariates, the association between NCD type and poor physical function was measured by using the Adjusted Risk Ratio (ARR) and Population Attributable Risk (PAR).* ***Results:*** *respondents with poor physical function were at a significantly increased of being diagnosed with stroke (ARR: 6.9, 95%CI: 4.3-10.9), diabetes (ARR: 3.1, 95%CI: 2.4-4.1), or heart disease (ARR: 3.2, 95%CI: 2.4-4.5). The PAR score of respondents with diabetes was 0.006, meaning 0.6% of diabetes cases are attributed to poor physical function and can therefore be prevented if people maintain good physical function.* ***Conclusion:*** *poor physical function can be assessed to identify risk of diabetes, heart disease, and stroke. Healthcare personnel should provide education programs that inform patients on the importance of maintaining a healthy physical ability.*

Keywords: *poor physical function, non-communicable disease, risk ratio, population attributable risk.*

INTRODUCTION

The burden of Non-Communicable Diseases (NCDs) poses major public health challenges to economic development worldwide. Approximately 36 million deaths that occurred globally in 2017 were due to NCDs, mainly cardiovascular diseases (31%), cancers (16%), chronic respiratory diseases (7%), and diabetes (3%).[1] In Asia, 382 million people have diabetes, and over 60% of this group may continue to develop cardiovascular diseases like heart disease and fatal stroke.[2] According to the Indonesia Basic Health Research 2018, the following NCDs increased in prevalence between 2013 and 2017: cancer (1.4% to 1.8%), stroke (7% to 10.9%), diabetes (6.9% to 8.5%) and hypertension (25.8% to 34.1%).[3]

Most of NCD contributed from modifiable behavioral and metabolic risk factors.[4] Therefore, common modifiable behavioral risk factors such as tobacco use, unhealthy diet, physical inactivity, and alcohol abuse will increase loss of life expectancy by six years due to chronic diseases, which developing countries are particularly susceptible to.[5,6] Moreover, the prevalence increases of metabolic risk factors such as high blood pressure, hyperglycemia, and hyperlipidemia add the risk of having NCD.[7] Some studies have investigated the poor physical function as a potential risk factor of having NCD for aging population.[8–10] However, it cannot be ascertained whether an individual with poor physical function will be at the increased risk for NCDs.[11,12] The result related to this study is still limited in Indonesia.

The aim of this study is to determine whether poor physical function is a risk factor for NCDs in Indonesia. Understanding this potential association is essential for helping healthcare professionals address the burden of NCDs in Indonesia.

METHODS

A fixed, retrospective cohort study has been conducted by using a set of public data from the Indonesia Family Life Survey (IFLS) 2007-2014. IFLS data is an ongoing series survey data collected by interviewing the same respondents at different time points. Specifically, it has been conducted five times (1993, 1997, 2000, 2007, and 2014). IFLS data was used to select 13 of 27 provinces and represented 83% of the Indonesian population.[13] The study has been approved by the Ethics Committee of Sekolah Tinggi Ilmu Kesehatan Indonesia Maju, reference number: 3666/Sket/K/RE/STIKIM/X/2019.

All respondents with a minimum age of 15 years old who were not diagnosed with diabetes, hypertension, high cholesterol (LDL), heart attack, coronary heart disease, angina, other heart problems, stroke, cancer, or a malignant tumor in 2007 were included in this study. Pregnant women and respondents who were not able to be traced and have several missing data from 2014 were excluded. Finally, 6,863 respondents were successfully tracked for this study.

The dependent variable in this study was NCD type, which included diabetes, heart disease, stroke, and cancer. The independent variable was a physical function measurement derived from participants' abilities to carry heavy loads, sweep the floor yard, draw a pail of water from a well; bow, squat, and kneel; stand-up from a sitting position on the floor without help; dress without help; and bathe without help. Respondents who were able to easily complete those activities by themselves were categorized as having a good physical function, while respondents with difficulties in those activities and need some help or feel sick after doing those activities by themselves were categorized as having a poor physical function.[14–15]

Covariates from this study included groups for age, gender, body mass index (BMI), smoking status, and routine physical activity, which have already been proven in previous studies to significantly increase individual risk for NCDs.[7,16,17]

The characteristics and physical functioning measures from every individual who met the criteria of respondent were described in 2007 as a baseline data. This study traced the same respondents in the 2014 as a follow up data. There were no respondents who lost to follow up and left from this study since the design was a fixed retrospective cohort. The IFLS data were analyzed by describing the characteristics of the same respondents and the proportion of

the physical functioning measures in 2007 and 2014. The cumulative incident of NCDs in 2014 was described by physical functioning measures.

Multivariate analysis was conducted by using multiple logistic regression to determine the association between poor physical function and risk for NCDs after being controlled for covariates. The Adjusted Risk Ratio (ARR) was used to measure the risk association, whereas the Population Attributable Risk (PAR) was used to evaluate the significant effect between the dependent and independent variables.

RESULTS

Most of the respondents' characteristics are associated with deteriorating physical function from 2007 to 2014 (**Table 1**). Of the 6,863 respondents in 2014, those with poorer physical function included elderly (55.36%), married (45.11%) and female (40.32%) participants. In 2007, 90.78% of active smokers had good physical function; however, this number decreased in 2014 (76.06%).

The percentage of respondents with difficulties in carrying heavy loads increased from 10.62% (2007) to 26.72% (2014). There were also increases in the difficulty to sweep the house floor and yard; draw a pail of water from a well; bow, squat, and kneel; and dress or bathe without help (**Table 2**).

In 2014, the cumulative incident of NCDs for diabetes, heart disease, stroke and cancer are 3.73%, 2.68%, 1.49%, and 6.6‰, respectively. Respondents with diabetes (8.59%), heart disease (14.13%), stroke (18.63%) and cancer (20%) in 2014 had the most difficulty in carrying heavy load in 2007 (**Figure 1**). Stroke respondents had difficulties in standing up from sitting, bowing, drawing a pail of water at 6.86% in 2007. Only respondents with stroke in 2014 had difficulty in bathing without help (9.8‰) in 2007.

All variables included in the multivariate analysis met the requirements of the bivariate analysis, and there were no concerns with heteroscedasticity ($p>0.05$). After controlling for covariates, respondents with poor physical

Table 1. Characteristics of respondents by the category of physical function (N=6,863).

Variables	Physical function in 2007 (%)			Physical function in 2014 (%)		
	Total	Poor	Good	Total	Poor	Good
Gender						
- Male	43.06	7.38	92.62	43.06	22.60	77.40
- Female	56.94	16.76	83.24	56.94	40.32	59.68
Age						
- 15-26 (young)	0.01	0.00	100	0	0.00	100
- 26-56 (productive age)	69.94	8.02	91.98	46.77	21.46	78.54
- 56-65 (retirement)	19.35	16.27	83.73	29.99	30.13	69.87
- > 56 (elderly)	10.70	37.06	62.94	23.24	55.36	44.64
Marital Status						
- Single	17.21	24.56	75.44	1.30	31.90	68.10
- Married	82.79	10.26	89.74	98.70	45.11	54.89
BMI						
- <18.5 (underweight)	13.10	20.13	79.87	14.15	29.55	70.45
- 18.5-24.9 (normal)	58.57	11.37	88.63	54.29	24.61	75.39
- ≥25 (overweight)	28.33	12.09	87.91	31.56	30.15	69.85
Physical Activity						
- Active	35.96	6.85	93.15	45.90	23.97	76.03
- Sedentary	64.04	16.02	83.98	54.10	38.70	61.30
Smoking habit						
- Active smokers	41.25	9.22	90.78	43.71	23.94	76.06
- Non-smokers	58.75	15.18	84.82	56.29	38.73	61.27

Table 2. Physical functioning measures in 2007 and 2014.

Composite of Physical Function	Scale	2007	2014
Carry heavy load	- Easily	89.38	73.28
	- With difficulty	10.62	26.72
Sweep the house floor yard	- Easily	98.50	85.98
	- With difficulty	1.50	14.02
Draw a pail of water	- Easily	95.06	93.18
	- With difficulty	4.94	6.82
Bow, squat, and kneel	- Easily	96.77	95.86
	- With difficulty	3.23	4.14
Stand up from sitting on the floor	- Easily	97.58	98.15
	- With difficulty	2.42	1.85
Dress without help	- Easily	99.62	98.82
	- With difficulty	0.38	1.18
Bathe without help	- Easily	99.61	98.05
	- With difficulty	0.39	1.05

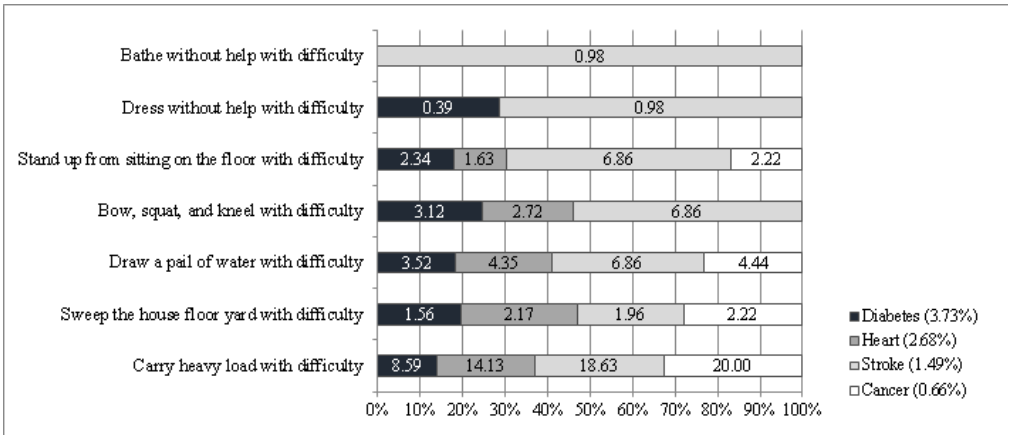

Figure 1. The cumulative incident of NCDs in 2014 by poor physical function in 2007.

function are at a significant risk of being diagnosed with stroke (ARR: 6.9, 95% CI: 4.3-10.9), diabetes mellitus (ARR: 3.1, 95% CI: 2.4-4.1), and heart disease (ARR: 3.2, 95% CI: 2.4-4.5) (**Table 3**). The PAR score of respondents with diabetes was 0.006, meaning 0.6% of diabetes cases are attributed to poor physical function and can therefore be prevented if people maintain good physical function.

Among the covariates, retirement age was associated with a high risk of stroke (ARR: 3.4 95% CI: 1.9-5.9), heart disease (ARR: 2.1 95% CI: 1.5-3.1), and diabetes (ARR: 2.1 95% CI: 1.6-2.7) (**Table 3**). Respondents who were overweight were also at significant risk for stroke (2.4 times), heart disease (1.9 times) and diabetes (1.8 times). The PAR score of overweight to the risk of diabetes is 0.004, meaning 4‰ can be prevented if people are not overweight.

DISCUSSION

Based on the results of this study, poor physical function is positively associated with risk for diabetes, heart disease, and stroke but is not significantly correlated with cancer risk (**Table 3**). These results are supported by other studies that report an association between poor physical function and risk for diabetes, prior stroke, depression, heart attack, and arthritis after adjusting for age, sex, education, income,

Table 3. Result of multivariate analysis.

Variables	Diabetes		Heart Disease		Stroke		Cancer	
	ARR	PAR	ARR	PAR	ARR	PAR	ARR	PAR
Poor physical function	3.1***	0.006***	3.2***	0.004***	6.9***	0.004***	1.6	
	(2.4-4.1)	(0.004-0.007)	(2.4-4.5)	(0.003-0.005)	(4.3-10.9)	(0.003-0.005)	(0.8-3.1)	
Male gender	1.1		1.1		1.1		0.8	
	(0.8-1.5)		(0.7-1.5)		(0.7-1.6)		(0.4-1.5)	
56-65 (retirement)	2.1***	0.004***	2.1***	0.002***	3.4***	0.002***	1.9*	0.0006*
	(1.6-2.7)	(0.002-0.005)	(1-5-3.1)	(0.001-0.003)	(1.9-5.9)	(0.00-0.003)	(0.9-3.6)	(0.00-0.008)
>65 (elderly)	1.1		1.9**	0.001***	4.3***	0.002***	1.2	
	(0.7-1.6)		(1.3-2.6)	(0.00-0.002)	(2.4-7.7)	(0.001-0.003)	(0.5-2.9)	
BMI <18.5 (underweight)	0.5***	0.009***	0.8		1.2		1.0*	0.0006*
	(0.3-0.8)	(0.004-0.137)	(0.5-1.2)		(0.7-2.1)		(0.1-1.0)	(0.00-0.001)
BMI ≥25 (overweight)	1.8***	0.004***	1.9***	0.003***	2.4***	0.002***	0.9	
	(1.4-2.4)	(0.001-0.005)	(1.3-2.5)	(0.001-0.003)	(1.5-3.7)	(0.00-0.002)	(0.5-1.8)	
Routine physical activity	1.1		1.2		0.8		1.4	
	(0.8-1.4)		(0.8-1.6)		(0.5-1.2)		(0.7-2.5)	
Active smoker	1.3**		1.4**	0.002***	2.2**	0.001***	1.1*	0.0006*
	(1.1-1.7)		(1.0-1.9)	(0.00-0.003)	(1.5-3.3)	(0.00-0.003)	(0.5-1.8)	(0.00-0.001)
Constant	0.0***		0.0***		0.0***		0.0***	
	(0.0-0.0)		(0.0-0.0)		(0.0-0.0)		(0.0-0.0)	

ARR, Adjusted Risk Ratio; PAR, Population Attributable Risk; *** p<0.01, ** p<0.05, * p<0.1

and lifestyle.[8,9] In addition, improving physical function in older adults is protective against cardiovascular disease.[10] There is also one study which stated that physical function is not significantly correlated with cancer risk.[12]

Poor physical function might become one of the risk of having NCD because it is closely related to the decreasing and weakness of muscle strength, aerobic endurance, flexibility, agility, balance and cardio pulmonary.[15,18] These degenerations can cause premature aging, body systemic inflammation and the decreasing of insulin sensitivity.[19] In long term, it could manifest metabolic disorders and having NCD. This degenerative condition might be caused from sedentary habit, carcinogens present in cigarette smoke, hazardous chemicals from the food product, ultraviolet radiation from sunlight and other air pollutions which is contaminated in the body.[19,20]

The analogy of poor physical function as the risk of having NCD in this study is the same as the condition of overweight and obesity which could increase the metabolism disorders and increase the risk of NCD which have been proved in various studies.[7,16,17] However, some of patients with NCD were also experiencing to have physical disability which have more severe characteristics than poor physical function.[21] Nevertheless, poor physical function in this study is the degeneration that occurs in the people who have not been diagnosed with NCD by medical personnel before.

The criteria of poor physical function in this study have been stated in the previous studies with different scale. The composite physical function scale that is developed by Jessy and Roberta has similar criteria to this study and divides the scale into 3 parts (able to do own activity without help, able to do with help, and not able to do the activities alone).[15] Other study to measure the physical function is done by using a Likert scale.[14]

In this study, the proportion of poor physical function increased from 2007 to 2014 with the exception of standing up from a sitting position on the floor (**Table 2**). This may be under-reported due to the lack of a surveillance program for detecting and controlling that epidemics early.[22] In Indonesia, the Ministry of Health focuses on 12 targets of the Health Family

Indicator, including prevention of smoking habits, participation in the National Health Insurance (NHI), and hypertension control, but there is currently no target for preventing deterioration of physical function.[23] Therefore, this study recommends that health personnel in primary health care monitor the incidence of poor physical function in Indonesia.

Respondents with NCDs in 2014 had greater poor physical function in carrying heavy load with difficulty in 2007 (**Figure 1**). It might happen due to the reduces ability of the body to maintain the structural power, metabolic, hormonal, neural and molecular adaptation as well as oxidative enzyme activity hence increasing risk of suffering from NCD.[22,24–26] Respondents with Activity Daily Living (ADL) impairment such as difficulty for bathing, dressing and standing up from sitting on the floor in 2007 displayed having NCDs in 2014 (**Figure 1**). Some studies also found significant association between ADL impairment and having NCD.[9,27] Routine doing physical activity with the right duration, intensity, and planned is the key for maintaining good body physical function to do ADL.[10]

This study showed that respondents in retirement ages were 3.4 times more likely to be diagnosed with stroke, heart disease (2.1 times), diabetes (2.1 times) and cancer (1.9 times) (**Table 3**). This may be due to poor physical function which cause the premature aging, the increasing of age, and the increasing of the incidence of disease.[11,28] Furthermore, most retirees also display problems with cognitive function, difficulties in walking, ADL impairment, and higher risks of metabolic syndrome, namely cardiovascular disease.[28]

The major strength of this study is the longitudinal period follow up between 2007 and 2014 to determine whether poor physical function increases risk for NCDs. The limitation of this study is that all variables were collected from IFLS data. Further study on the association of poor physical function and the risk of NCDs can be conducted by using primary data.

CONCLUSION

Poor physical function can be assessed to identify risk for diabetes, heart disease, and stroke, but it is not a significant indicator for cancer risk in Indonesia. While they are still young and able, people should maintain their physical function as much as possible through routine physical activity to minimize risk of NCDs while aging. Healthcare personnel should monitor the incidence of poor physical function and provide health education programs to help inform patients on the importance of maintaining a healthy physical ability.

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