# Self-efficacy in physical activity and glycemic control among older adults with diabetes in Jagir Subdistrict, Surabaya, Indonesia

*by* Trias Mahmudiono

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Research article

# Self-efficacy in physical activity and glycemic control among older adults with diabetes in Jagir Subdistrict, Surabaya, Indonesia

Trias Mahmudiono[a,*], Stefania W. Setyaningtyas[a], Qonita Rachmah[a], Triska S. Nindya[a], Hario Megatsari[b], Diah Indriani[c], Mahmud A. Rifqi[a], Wantanee Kriengsinyos[d]

[a] Department of Nutrition, Faculty of Public Health, Universitas Airlangga, Surabaya 60115, Indonesia
[b] Department of Health Promotion and Behavioral Science, Faculty of Public Health, Universitas Airlangga, Surabaya 60115, Indonesia
[c] Department of Biostatistic and Population, Faculty of Public Health, Universitas Airlangga, Surabaya 60115, Indonesia
[d] Institute of Nutrition, Mahidol University, Nakhon Pathom 73170, Thailand

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ABSTRACT

Diabetes in older adults has shown an increase in prevalence, especially in urban areas of Indonesia. This study aimed to assess the relationship between self-efficacy in physical activity and glycemic control in older adults' population with diabetes mellitus in Indonesia. This research used cross sectional design that involved 52 adults with diabetes, aged between 55-90 years old who regularly attended the older adult's health post (Posyandu Lansia) at Jagir Sub-district, Surabaya. Those who had physical disabilities were excluded from the study. Questionnaires were used to measure the physical activity and two types of self-efficacy whilst the glycemic control was measured using HbA1c in basal condition. The relationship between the variables was tested using Pearson and partial correlation test. Results show that the level of physical activity was insufficient (216.4 ± 343.5 MET) with only 32.7% (N = 17) of the participants was categorized as being physically active. The mean of the HbA1c indicated poor glycaemic control (8.63 ± 2.34%) with majority of them (76.9%, N = 40) was in the poor glycaemic control group (HbA1c ≥ 6.5%). Their self-efficacy was at the average level (Against the barriers:52.65 ± 13.23; Engage in physical activity: 59.06 ± 26.2). The self-efficacy in performing the physical activity was found significantly related to the duration of physical activity (r = 0.278, p = 0.046). Other relationships, however, were not significant (p > 0.05). In conclusion, self-efficacy to engage in physical activity is paramount to increase the physical activity among the older adults. Nevertheless, further longitudinal research on self-efficacy in physical activity management is needed.

## 1. Introduction

Diabetes mellitus is a degenerative disease whose prevalence continues to increase yearly. Data from the International Diabetes Federation showed that the prevalence of diabetes worldwide in 2017 was 8.7% (Cho et al., 2018). This number has risen significantly relative to the prevalence rate of diabetes in 2013, which was 8.3% (Guariguata et al., 2014). Generally, the prevalence is rising more severely in lower-middle-income countries (Cho et al., 2018; World Health Organization [WHO], 2016b); indeed, the WHO predicted in 2016 that the prevalence of diabetes mellitus in lower-middle-income countries would experience the most rapid increase from that point on as compared within other countries (WHO, 2016b).

As the prevalence of diabetes in the world increases, the percentage of diabetes mellitus in Indonesia is also showing a similar trend. In 2013, it was found that the prevalence of diabetes in Indonesia was 1.5% (Ministry of Health Republic of Indonesia, 2013), while that in 2007 was 1.1% (Ministry of Health Republic of Indonesia, 2007).

As people age, their risk of developing diabetes mellitus grows. The proportion of diabetics 50 years of age and older is larger than that of those younger than 50 years of age (Cho et al., 2018). This trend occurs because, as the age increases, the functions of almost all body cells—including the ability of pancreatic cells to produce insulin and the insulin receptor sensitivity of cells that play a role in capturing insulin—decrease. In addition, lifestyle factors such as obesity, a lack of physical activity, and the consumption of saturated fats can also contribute to an increased risk of diabetes mellitus in older adults (Kirkman et al., 2012; Meneilly and Tessier, 2001). Several studies have suggested to date that the factors most associated with aging-related

* Corresponding author.
*E-mail address:* trias-m@fkm.unair.ac.id (T. Mahmudiono).

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insulin resistance are obesity and physical inactivity (Amati, 2009; Mayer-Davis et al., 1998).

The onset of aging-related insulin resistance is attributed specifically to an increase in intramyocellular fatty acid metabolites that leads to mitochondrial dysfunction (Kim et al., 2008; Petersen et al., 2003). One of the hallmarks in the aging process is body composition changes; during aging, the fat oxidation rate tends to slow down, which results in a gradual accumulation of body fat in the cells. These changes might lead to a decrease in the mitochondrial oxidative capacity (Phielix et al., 2011). Some studies have suggested that aging-related insulin resistance can be managed by physical activity (Kim et al., 2008; Kubota et al., 2006; Taylor et al., 2004); to date, several studies have shown that aerobic exercise led to a beneficial effect on glucose metabolism in older adults (Chodzko-Zajko et al., 2009; Ryan, 2010; Short et al., 2003).

Indonesia is a developing country with a high prevalence of physical inactivity. It is known that 22.8% of Indonesia's population is classified as showing low levels of physical activity (WHO, 2016a). In addition, the American College for Sports Medicine stated that older populations do not exhibit sufficient levels of both the frequency and intensity of physical activity due to a decrease in exercise tolerance (Chodzko-Zajko et al., 2009). Many factors can lead to physical inactivity among elders, including psychosocial and environmental factors (Bauman et al., 2012; Chaudhury et al., 2016). Low levels of physical activity are thought to occur due to urbanization and modernization (Popkin et al., 2013).

Several studies have mentioned that self-efficacy induces better medical adherence, thus potentially improving glycemic control in individuals with type 2 diabetes (Gao et al., 2013; Shao et al., 2017; Wichit et al., 2017). As such, one study involving Omani adults revealed that patients with type 2 diabetes and poor glycemic control were more likely to also exhibit poor self-efficacy and self-care behaviors (D'Souza et al., 2017).

Self-efficacy is a theoretical approach used to measure a person's belief in their capabilities to successfully execute a necessary course of action based on situational conditions (Bandura and Ramachaudran, 1994). The self-efficacy questionnaire did not require a long recall period so it was not believed to place an inappropriate burden on older adults. In addition, a study did mention that reducing the burden on aging individuals can be achieved by asking shorter and simpler questions (Knäuper et al., 2016); thus, we simplified the self-efficacy questionnaire to shorten the recall time and lower the burden. Some of studies have also suggested that self-efficacy is a significant predictor of exercise adherence and compliance (King et al., 2010; McAuley and Blissmer, 2000). Self-efficacy can influence someone's choice regarding the frequency, type, and duration of exercise they adopt (McAuley and Blissmer, 2000). This study aimed to assess the relationship of self-efficacy in physical activity and glycemic control indicated by the glycated hemoglobin (HbA1c) level among older adults in Jagir Subdistrict, Surabaya, Indonesia.

## 2. Results

### 2.1. Characteristics of participants

The total number of eligible individuals was 325 and, ultimately, 60 older adults who met the study criteria participated in this study. However, eight of these participants did not complete the questionnaire, so the final sample size was 52 participants. The participants' characteristics are shown in Table 1.

### 2.2. Physical activity

To measure the mediating variable between self-efficacy toward physical activity and glycaemic control, a physical activity level measurement was performed and the resultant value was expressed as min/week. As shown in Table 1, the average duration of daily moderate and heavy physical activity was 216.4 ± 343.5 min/week, indicating an insufficient level of activity. Only 32.7% (n = 17) of the study participants were physically active, in that they performed moderate aerobic physical activity for than 300 min/week.

**Table 1.** Characteristics, glycaemic control, physical activity, and self-efficacy in physical activity of study participants.

| Variable | Mean ± SD or Frequency, n (%) |
|---|---|
| Sex | |
| Male | 16 (30.8) |
| Female | 36 (69.2) |
| Age (years) | 66.8 ± 5.39 |
| Occupation | |
| Employed | 9 (17.3) |
| Unemployed | 43 (82.7) |
| HbA1c (%) | 8.63 ± 2.34 |
| <6.5% | 12 (23.1) |
| ≥6.5% | 40 (76.9) |
| Self-efficacy | |
| Against the barrier | 52.65 ± 13.23 |
| Engage with physical activity | 59.06 ± 26.2 |
| Physical activity (min/week) | 216.4 ± 343.5 |
| Physically active | 17 (32.7) |
| Physically inactive | 35 (67.3) |

### 2.3. Self-efficacy in physical activity

This study assessed the self-efficacy in physical activity through several questions concerning a participant's ability to overcome barriers to and engage in physical activity. The mean ± standard deviation values of self-efficacy against barriers and self-efficacy to engage in physical activity were 52.65 ± 13.23 and 59.06 ± 26.2, respectively (Table 1). This study found that self-efficacy to engage in physical activity was significantly positively related to the mean of physical activity ($r = 0.278$; $p = 0.046$). However, there was no correlation between self-efficacy against the barriers to physical activity and the duration of physical activity per day ($p = 0.426$).

### 2.4. Glycemic control

Glycaemic control, the main dependent variable of this study, was assessed according to HbA1c level and it was revealed that the HbA1c level was 8.63% ± 2.34%, suggesting a high rate of poor glycaemic control. Findings concerning glycaemic control based on two categories of HbA1c level (<6.5% vs. ≥ 6.5%) further revealed that majority of participants (n = 40; 76.9%) had high HbA1c levels (≥6.5%) (Table 1). The HbA1c level was found to have a negative correlation with age among the study participants ($r = 0.285$; $p = 0.04$). On the other hand, there was no significant correlation between physical activity and the HbA1c level ($p = 0.293$). There was also no significant correlation found between the two types of self-efficacy and the HbA1c level ($p = 0.1974$, self-efficacy against barriers to physical activity; $p = 0.545$, self-efficacy to pursue physical activity).

### 2.5. Adjusted correlation

Table 2 shows the results pertaining to the relationship between both types of self-efficacy and HbA1c while controlling for age and physical activity. The partial correlation was done twice. The first partial correlation was performed by controlling the age, whereas the physical activity was added in the second partial correlation. Both models of correlation indicated that there was no significant correlation between either type of self-efficacy or the HbA1c level ($p > 0.05$).

**Table 2.** Correlation between self-efficacy and HbA1c.

| Independent Variable | R | p-value |
|---|---|---|
| Model 1[a] | | |
| Self-efficacy against barriers | −0.171 | 0.194 |
| Self-efficacy to pursue physical activity | 0.086 | 0.545 |
| Model 2[b] | | |
| Self-efficacy against barriers | −0.150 | 0.293 |
| Self-efficacy to pursue physical activity | 0.018 | 0.899 |
| Model 3[c] | | |
| Self-efficacy against barriers | −0.132 | 0.361 |
| Self-efficacy to perform physical activity | 0.033 | 0.820 |

[a] Bivariate correlation.
[b] Partial analysis by controlling the age variable.
[c] Partial analysis by controlling the age and duration of physical activity variables.

## 3. Discussion

This study aimed to assess the relationship between self-efficacy in physical activity and glycaemic control among older adults with diabetes at five health posts in Jagir Subdistrict, Surabaya, Indonesia. Findings indicate that the older adults in this study had insufficient level of physical activity with the majority of them being physically inactive. Their glycaemic control was also poor of which many of them had the poor control. Their self-efficacy in against the barriers toward physical activity and self-efficacy in their ability to perform the activity were both at the average level only. Whilst self-efficacy against barriers had no influence on their physical activity, the other self-efficacy did play a role on physical activity. In particular, engagement in the physical activity was higher as that particular self-efficacy increased. For the glycaemic control, it was found that it increased as the participants' age was younger. The glycaemic control, nevertheless, did not have a relationship with physical activity and both types of self-efficacy.

The finding for the physical activity in this study is not surprising since the participants lived in an urban area. According to Popkin et al. (2013), urbanization makes the transportation access easier which this leads people in the urban area often become physically inactive and have more sedentary lifestyle. In addition, the participants' houses were located in dense settlement with no recreational or sport facilities around the housing.

Bandura's Social Cognitive Theory (Bandura and Ramachaudran, 1994) has suggested that a person's behaviours would increase if the self-efficacy increases. Many studies have tested this suggestion and found that the increase in the physical activity in older adults with diabetes had relationship with the increase in the self-efficacy of the physical activity (King et al., 2010; Taylor et al., 2004). This result, however, is consistent to the finding of the present study for the self-efficacy in performing physical activity only. The self-efficacy on barriers, on the other hand, is contrary to the previous study (King et al., 2010). The contradicting result could be explained by an interrelation of various factors that we did not focus on in this study, such as the balance between food intake, physical activity, and the rate of aging, which can influence glycemic control of the participants.

Physical activity has long been known to have beneficial effect on the glycemic control (Ekelund et al., 2009; Mayer-Davis et al., 1998; Taylor et al., 2004). However, the physical activity must be done at the recommended level with minimum 3 days per week for adult and older adults (WHO, 2010b). Although physical activity and glycaemic control was not found related in this study, the poor glycaemic control as indicated by the high level of HbA1c could reflect the insufficient physical activity level.

HbA1c is often used as the objective measurement of diabetes self-management (e.g., physical activity, diet and medication adherence). Many studies that have examined the relationship between self-efficacy and HbA1c reported a significant relationship between these two variables (Al-Khawaldeh et al., 2012; Gao et al., 2013; O'Hea et al., 2009). Nevertheless, the current study did not find similar relationship. This could be due to various factors such as the balance between food intake, physical activity, as well as the rate of aging process can influence glycemic control of the participants.

However, the use of the cross-sectional design in this study hinders the inference of causality relationships between the study variables. Another limitation is the possibility of measurement bias related to the interview. In particular, the interview could be interrupted by other older adult members. In order to minimize this kind of bias, the interview process was held in separated rooms but in the same location of *Posyandu Lansia*. In addition, recall bias could arise from the ability of the participants to remember things related to the answers since we used older adults as the participants. We minimized this recall bias by shortening the retrospective time period of the questions and crosschecking the answers with family members living in the same house with the participants. The strength of the study includes the use of HbA1c as standard measure for diabetes mellitus which rarely used in the Indonesian setting due to its relatively expensive test. It is believed that this study is among the few, if not the first to report the outcome of diabetes mellitus in a community setting in Indonesia using HbA1c.

Future research using direct measurement tools such as pedometer or accelerometer is recommended. Furthermore, assessing the use of diabetes medication among the participants should be considered. All of the participants were previously registered as a member of the Older Adult Health Post (*Posyandu Lansia*). Hence, it is indicated that participants' access to health facilities and medication was high. Longitudinal or experimental study that assess the relationship between self-efficacy toward physical activity and glycemic control in older adults is needed for stronger evidence.

## 4. Conclusion

There was no significant correlation between self-efficacy in physical activity and the HbA1c level among the participants of this study. It has been known that HbA1c level may be affected by other care practices such as diet or medication, yet these variables were not included in this research. Future research assessing the self-efficacy toward other diabetes management behaviors could provide further perspectives about the role of self-efficacy in glycemic control. The use of direct physical activity measurement tools is also recommended. Moreover, a longitudinal design to assess the relationship of self-efficacy toward physical activity and glycemic control in the older adults over time is also needed.

## 5. Materials and methods

### 5.1. Design and setting

This study involved secondary analysis of data previously collected for the purpose of measuring self-efficacy and overcome barriers to engage in physical activity, sedentary behavior, and their relation to body mass index among elderly Indonesians with diabetes (Rachmah et al., 2019). This study expanded the analysis of previously published study (Rachmah et al., 2019) and focused its analysis on the association between self-efficacy in physical activity and glycemic control among older adults with diabetes in Jagir Subdistrict, Surabaya, Indonesia. This study used quantitative approach with cross sectional study design. The study was held in Surabaya City, the second largest city of Indonesia. Research took place at the Jagir Sub-district, located in the heart of the city. This involved five different health posts for older adults (*Posyandu Lansia*). The health posts were chosen as all the older adults registered under them lived in a similar type of housing area which belongs to dense settlement and had comparable public recreational facilities.

### 5.2. Study samples

There were 1020 older adults in Jagir Sub-districts registered under the five health posts. Of this, 325 people suffered from diabetes. Samples for this study were selected from this population using the simple random sampling method. Inclusion criteria were fluent in conventional Bahasa Indonesia, was a permanent resident and planning to stay in Surabaya City for at least six months and aged between 55-90 years old. However, they were excluded if they had physical disability. Sample size calculation was determined using several considerations. Assuming that diabetes prevalence in Indonesia was 2.5% (Ministry of Health Republic of Indonesia, 2013), the minimum sample size calculated based on Charan and Biswas equation (Charan and Biswas, 2013) was 38 persons. While using sample size calculation for difference in 2 independent proportions, and the minimum sample size required was 50 (Rachmah et al., 2019). A larger sample size (N = 60) was recruited in order to achieve study power of 1.0. Among the initial samples recruited, 56 participants completed anthropometric measurement as well as all questionnaires on self efficacy and physical activity, however only 52 older adults complete HbA1C measurement. Hence, the final sample to be analyzed in this study was 52 because some of the older adults did not complete HbA1C measurement.

### 5.3. Variable measurement

#### 5.3.1. Self-efficacy in physical activity

Based on the Bandura's Social Cognitive Theory (Bandura and Ramachaudran, 1994), a questionnaire was developed to measure the self-efficacy in physical activity for this study. The questionnaire measured two domains of self-efficacy in physical activity; self-efficacy against barriers to physical activity (10 questions) and self-efficacy to do physical activity (8 questions). Participants were asked to rate their self-efficacy against 10 scenarios of barriers towards engaging in physical activity. The scenarios were: (1) tired, (2) bad weather, (3) facing personal problems, (4) depression, (5) anxious, (6) injuries or illness, (7) feeling uncomfortable walking, (8) holidays, (9) too much work, and (10) having other interesting agendas. The self-efficacy to do physical activity rated participants' confidence to engage in walking which divided into: (1) 1,000 step/day, (2) 2,000 step/day, (3) 3,000 step/day, (4) 4,000 step/day, (5) 6,000 step/day, (6) 8,000 step/day, (7) 10,000 step/day, and (8) 12,000 step/day. Participants rated their confidence in overcoming barrier or engaging in a specific amount of physical activity on a scale from 0 to 100. The mean scores of each self-efficacy domain were calculated for further analysis with higher score indicating higher self-efficacy. Using the Cronbach Alpha, we assessed those measures of self-efficacy used were reliable ($\alpha = 0.682$ for self-efficacy against barriers to physical activity and $\alpha = 0.576$ for self-efficacy to do physical activity). The questionnaire was written in Bahasa. To minimize the misleading interpretations of the questions, the trained enumerators interviewed the participants to fill the answer in the questionnaire.

#### 5.3.2. Glycemic control

Glycaemic control was measured using a glycated hemoglobin (HbA1c) test administered by certified health analysts. The blood-drawing process for all participants was completed in the morning, where as much as 2 cc of blood was drawn from the median cubital vein using a vacuum syringe. The HbA1c was analyzed using an ion-exchange HPLC method using the Variant™ system. Blood samples were not stored for future analysis. The average duration between the day of the last HbA1c measurement and the day of survey completion was less than one month, with HbA1c measurements performed after completion of the survey.

#### 5.3.3. Physical activity level

The other variable measured in this study was physical activity level that was included as a controlled variable. This variable was assessed using the Global Physical Activity Questionnaire (GPAQ) (WHO, 2010a) in order to gain the information about frequency, type, and duration of physical activity which have been done by the participants over the past month. It consisted of four sections namely working, travelling, recreational, and sedentary activity. The result was then transformed into minute per week (MET) unit to describe physical activity level of the participants. Total physical activity MET was calculated by summarizing the minutes unit of activities multiplied by certain constants, i.e., 4 for moderate work, transportation activity, and moderate recreation, and 8 for vigorous work and recreational activities (WHO, 2010a). In the original GPAQ which targeted the general population, the cut-off point of 600 MET was usually referred to as the "active" category. However, since the participants of this study were older adults, we used cut-off points of minimum 300 MET to define whether the participants had sufficient physical activity (WHO, 2010b). The questionnaire was translated to Bahasa, and one on one interview was done to collect the data by trained enumerator.

### 5.4. Procedures of data collection

Data collection was conducted from August to September 2017. Eligible participants were identified through the health post database and given an explanation about this study. Those who agreed to participate were asked to sign an informed consent form. The research interview process was conducted in a separate room for each participant to avoid the possibility of interruption by other older adults. To minimize recall bias, participants' answers were crosschecked with family members who lived in the same house.

### 5.5. Statistical analysis

To assess the correlation between variables, Pearson's correlation with $\alpha = 0.05$ was performed using the Statistical Package for the Social Sciences version 21 software program (IBM Corporation, Armonk, NY, USA). In addition, partial correlation was also done to measure the degree of control held by potentially mediating or confounding variables over the main variable. In this case, the control variables were age and physical activity.

### 5.6. Ethics

This research complied with the standard Committee on Publication Ethics ethical guidelines and received approval from the institutional review board of the Faculty of Public Health, Universitas Airlangga on July 25, 2017 (reference or proposal no. 414-KEPK). This study was also approved by the Surabaya City Review Board (Bakesbangpol no:070/6275/436.8.5/2017). The dataset of the study will be made publicly available once this manuscript is published in the repository of Universitas Airlangga found on the following website: http://repository.unair.ac.id/.

## Declarations

### Author contribution statement

Trias Mahmudiono: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Triska Susila Nindya: Conceived and designed the experiments; Analyzed and interpreted the data; Wrote the paper.

Wantanee Kriengsinyos: Conceived and designed the experiments; Wrote the paper.

Stefania Setyaningtyas and Qonita Rachmah: Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Mahmud Aditya Rifki and Hario Megatsari: Performed the experiments.

Diah Indriani: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.

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*Data availability statement*

Data will be made available on request.

*Declaration of interests statement*

The authors declare no conflict of interest.

*Additional information*

No additional information is available for this paper.

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