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Random Blood Glucose Distribution in Three Different Communities Based Setting: A Pilot Study in Jakarta Area, Indonesia

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Abstract: Diabetes is acknowledged as one of the leading causes of death, including Indonesia which ranks 5th for the highest number of diabetic cases in the world (9.1 million cases). This situation might be worsened due to the high number of undiagnosed cases and the increase level of blood glucose serum (hyperglycemia status), specifically in Jakarta which is the capital city of Indonesia and the most populated city within the country. The aim of present study was to assess the prevalence and random blood glucose serum level distribution within three different communities based settings in Jakarta, which are office, healthcare facilities and residential based setting community. The main sample consisted of 1442 subjects who were participated in a cross-sectionally study design. The results showed that prevalence of subjects having random blood glucose serum above 200 mg/dL was 8.9%. The highest prevalence of community having random blood glucose above 200 mg/L was observed in primary health care (13%), followed by residential community (12.9%) and office community (12.5% for media, 1.7% for government; 1.7% for manufacturing and 0.7% for service). While random hyperglycemia status was more prevalent in male population (10.3 vs 8.3%) and oldest age group (0% for <17 year group; 0.8% for 18-27 year group; 3.3% for 28-37 year group; 7.6% for 38-47 year group; 10.6% for 48-57 age group and 12.9% for >58 year group). The creation of integrated intervention strategy to reduce the increasing number of hyperglycemia status should be encouraged. Furthermore, the initiatives created should be the responsibility of all related stakeholders in order to contribute to healthier in Jakarta.

Key words: Random blood glucose, office, health care, residential community, diabetes, employee

INTRODUCTION

Diabetes remains the major public health issue not only in worldwide but also in Indonesia. According to International Diabetes Federation (2014), Indonesia ranks 7th in the world with 7.6 million diabetes cases in 2013 and has increased to number 5th in 2014 with 9.1 million cases. Ironically, this number is still predicted to grow in the future due to the high number of undiagnosed diabetes cases and the increasing frequency of prediabetes cases in youth (CDC, 2014).

Prediabetes is defined as a condition in which someone having blood glucose levels that are higher than normal however not sufficient to be diagnosed as diabetes (American Diabetes Association, 2015). Although prediabetes is also considered as a global health problem and extremely important, there are no specific symptoms showed and this might lead to the undiagnosed case of prediabetes, which at the end resulted in diabetes development. Normally, prediabetes condition may be reversed through lifestyle modification, that involves nutrition education, behaviour modification and physical activity as the important steps to prevent the progression to diabetes (Cali and Caprio, 2008). However, this condition might worsened resulted in diabetes if there is no sufficient treatment and lifestyle modification. According to CDC Report (2015), persons with prediabetes are at high risk for developing type 2 diabetes, which accounts for 90-95% of all diabetes cases (CDC, 2015). Each year, 11% of persons with prediabetes who do not lose weight and do not engage in moderate physical activity will progress to type 2 diabetes during the average 3 years of follow up (Knowler *et al*., 2002). According to national study performed by Soewondo, Pradana and Pramono in 2011, it is found that prevalence of prediabetes is higher than diabetes, estimated around 10%, compare to another available report which is 1.1% according to Ministry of Health (2007). Prediabetes may developed due to several factors, such as increasing age, central obesity, obesity status and high socio-economic status. It is reported that in high socio-economic status, the opportunity of the sedentary lifestyle is bigger, while in low education level, the people has a lack of knowledge about prediabetes or diabetes prevention (Soewondo *et al*., 2011).

As the capital city of Indonesia, Jakarta is number one as the most populated city within the country and mostly consists of urban population which are high in diversity and dynamic (BPS, 2012). Erika and Kadek (2010)

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previously reported that urban population were having higher risk in developing prediabetes, particularly due to their unhealthy lifestyle or lifestyle modernization. This may lead to obesity which is the risk factor of prediabetes and diabetes (Erika and Kadek, 2010). Ministry of Health (2013) also stated that in Indonesia, prediabetes was shifting to younger age, around 38-47 years old. This phenomenon coupled with a Westernization lifestyle will further increase the risk of prediabetes in the country (Erika and Kadek, 2010).

Although most of the people in Jakarta area is categorized within a productive age group, in which they may work as an office employee or as a community volunteer around their residential, further research is still needed to assess their health status, particularly due to the lifestyle modernization as well as sedentary lifestyle. Therefore, the aim of this pilot study was to assess the risk of prediabetes and diabetes status, which may be pre-evaluated through random blood glucose level among the urban population in Jakarta area, such as in office based setting community, residential based setting community and healthcare facilities based community. This is important to perform an initial diagnosis in order to provide either prevention or management strategy for prediabetes and diabetes. The result of this study may also be used as a recommendation to develop a holistic yet integrated approach to develop healthier Jakarta population, specifically in diabetes management and prediabetes prevention.

MATERIALS AND METHODS

The main sample consisted of 4432 people in Jakarta who were categorized in three different communities based settings, which were subjects in office based setting community, residential based setting community and healthcare facilities based community. Data was collected during the blood glucose check program that conducted by Nutrition and Health Education Department, Nutrifood Research Center. Research sample was chosen by purposive sampling method with inclusion criteria was participated in the random blood glucose check and has completed the questionnaire. The study was conducted from January until May 2015. From 4432 respondents, the sampling process only obtained 1442 respondents to be analyzed in this study. This research was a cross-sectional study. All variables observed at the same time to see the magnitude of problem by its frequency and to explain the distribution of the variables in the population. Variables consist of random blood glucose serum which was taken using direct glucose finger prick test. This was done by assuring the respondent to not consume any food or beverage 2 h before test in order to increase the validity. The equipment used in this study is Accu Check 360° View.

As the cut-off value of random blood glucose check, this study followed ADA (American Diabetes Association) recommendation in 2014 which stated that the value >200 mg/dL is considered to be at risk in having either diabetes or prediabetes and <200 mg/dL is normal. However, due to the nature of random blood glucose checking, if one's result was above 200 mg/dL, the subject then was given advice to complete the test with other checking methods such as fasting blood glucose check (FPG), OGTT (Oral Glucose Tolerance Test) and HbA1c test in order to accurately diagnose whether one is having diabetes or not. Other data such as community type setting, sex and age were collected with interview using a structured questionnaire. If it was necessary, then an additional cross tab analysis was conducted to assess the relationship between each variable as a supporting data to the study discussion. Age group was classified based on previous study conducted by Soewondo *et al*. (2011). Univariate data analysis with 95% confidence interval was conducted to assess the frequency and distribution of all variables using SPSS version 21.

RESULTS

From 4432 respondents obtained by purposive sampling method, only 1442 respondents were included in final analysis after applying the inclusion criteria, which means the final response rate of this study was 32.54%.

More than half of the respondents in the study was coming from healthcare facilities based setting community (62.07%), followed by office based setting community (29.33%) and residential based setting community (8.60%) as shown in Table 1. The statistical analysis with 95% confidence interval showed the median value of random blood glucose level was 108 mg/dL with SD value was 59.32 mg/dL. 570 mg/dL was the highest value of random blood glucose level and 62 mg/dL was the lowest. The prevalence of having random blood glucose level above 200 mg/dL was 8.9% within this population as shown in Table 2.

The random blood glucose serum distribution within different community type, age and gender were summarized in Table 3. According to the community type, the highest prevalence of community having random blood glucose above 200 mg/L was observed in primary health care (13%), followed by residential based setting community (12.9%) and office based setting community (12.5% for media industry, 1.7% for government; 1.7% for manufacturing industry and the lowest was 0.7% for service industry). While random blood glucose serum level above 200 mg/L was more prevalent in male population compare to female population (10.3 vs 8.3%). Overall, the higher the age group, the bigger the prevalence of having random blood glucose level >200 mg/dL and the highest prevalence

Table 1: Population distribution within different community type

Group category	n	%
Residential community	124	8.60
Office		
Media	40	2.77
Government	60	4.16
Service	151	10.47
Manufacture	172	11.93
Healthcare facility		
Hospital	412	28.57
Primary health care	483	33.50
Total	1442	100.0

Table 2: Descriptive analysis of random blood glucose serum level

Blood glucose serum level	Value of 95% CI
Median	108 mg/dL
Lowest value	62 mg/dL
Highest value	570 mg/dL
SD	59.3 mg/dL
Prevalence of high blood glucose serum	8.9%

was found in 58+group, which was around 12.9% oldest age group as shown in Table 3. However, in the younger age group, the prevalence was also considered high, around 3.3% for 28-37 year age group and 7.6% for 38-47 age group as shown in Table 3.

DISCUSSION

Prevalence of random blood glucose level >200 mg/dL in the total population: The prevalence number of having blood glucose level >200 mg/dL in this population was about 8.9%. According to ADA (2015), cut off value of 200 mg/dL might indicate that subject may have the risk of developing diabetes and might developed prediabetes. However, for those who present with severe classic hyperglycemic symptoms or hyperglycemic crisis can continue to be diagnosed as having diabetes when a random plasma glucose of ≥200 mg/dL is found.

Nonetheless, due to the nature of random blood glucose test, if the respondents glucose check value >200 mg/dL was found in this study, these still could not be diagnosed as diabetes, thus this test needs to be completed with the other test methods, such as fasting blood glucose (FPG), HbA1c test, or OGTT (Oral Glucose Tolerance Test). Therefore, the prevalence number of having blood glucose level >200 mg/dL in this population (around 8.9%) might consists of diabetes respondents, prediabetes respondents, or respondents who were having high blood glucose when following the study.

Although this number was considered higher in comparison with the other diabetes cases reports (2.5% diabetes cases in Jakarta based on Ministry of Health (2013) and 5.83% diabetes cases in the nation based on IDF (2014), still this number is lower than prediabetes cases report which was approximately around 10% (Soewondo *et al*., 2011). Nonetheless, this was still considered as an enormous concern within the population.

Research has shown that high random blood glucose serum level has been linked with higher significant risks of mortality, particularly for those who present with diabetes (Krinsley and James, 2003). This is due to the increase risk of developing oxidative stress within diabetic patients (Monnier *et al*., 2006). Oxidative stress may induce the development of complications. On top of that, persistent hyperglycemia, secondary to insulin resistance, may induce oxidative stress and contribute to beta cell destruction in type 2 diabetes. Additionally, the complications development may lead to macro and microvascular damage and deterioration of pancreas (King and Mary, 2004).

Persistent hyperglycemia is not only damaging to diabetic patients, but also significantly associated with the lower health quality, both for prediabetic subjects as well as for those who are still considered as healthy person. For prediabetic, persistent hyperglycemia could contribute to faster rate of diabetes development (Nichols *et al*., 2007). A study showed that it only needs approximately 36.3 months to develop diabetes from prediabetes condition, thus this condition must be addressed immediately (Nichols *et al*., 2007). While for healthy person, high level of random blood glucose may lead to a more sustain and persistent hyperglycemia due to unhealthy lifestyle (Nichols *et al*., 2007). Additionally, in other diseases condition, high blood glucose level may also worsened their health status, for example, higher glucose concentration (in the range of 8.0-10.0 mmol/L) were associated with increased risk of congestive heart failure or cardiogenic shock in patients without diabetes. Patients without diabetes who had glucose concentrations more than or equal to range 6.1-8.0 mmol/L had a 3.9-fold higher risk of death than patient without diabetes who had lower glucose concentration (Capes *et al*., 2000).

Random blood glucose level distribution across different subgroups (gender, age and community type)

Gender: Overall, high random blood glucose level >200 mg/dL was more prevalent in male (10.3%) compare to female population (8.3%). This finding is consistent with the meta-analysis study conducted by Hilawe *et al*. (2013). They reported that impaired fasting glycemia was more common in male population than in female with OR 1.56 (Hilawe and Esayas, 2013). This might be explained by the dietary habit or food consumption pattern. According to one local survey study in Yogyakarta (2014), in average, fat intake was higher in male population (67.10 g) compare to female (62.85 g)(Studi Diet Total Survei Konsumsi Makanan Individu Daerah Istimewa Yogyakarta, 2014). This might be due to the higher avoidance rate in women to fatty foods compare to men and women generally showed a

Table 3: Distribution of random blood glucose serum

	Blood glucose serum category (ADA, 2014)				
	<200 mg/dL		≥200 mg/dL		Total
Characteristics	n	%	n	%	n
Group category					
Residential based	108	87.10	16	12.90	124
Office based					
Government	59	98.30	1	1.70	60
Media	35	87.00	5	12.50	40
Service	150	99.30	1	0.70	151
Manufacture	169	98.3	3	1.70	172
Healthcare facility based					
Hospital	373	90.50	39	9.50	412
Primary healthcare	420	87.00	63	13.00	483
Sex					
Female	920	91.70	83	8.30	1003
Male	394	89.70	45	10.30	439
Age					
≤17 years old	5	100	0	0	5
18-27 years old	128	99.20	1	0.80	129
28-37 years old	208	96.70	7	3.30	215
38-47 years old	230	92.40	19	7.60	249
48-57 years old	311	89.40	37	10.60	348
≥58 years old	432	87.10	64	12.90	496

Table 4: Age group and percentage of diabetes cases (Minisry of Health, 2013)

Age group	Percentage
15-24	0.1
25-34	0.3
35-44	1.1
45-54	3.3
55-64	4.8
65-74	4.2
75	2.8

tendency to perform healthier choices and much more concerned about the importance of food choice to stay in a good physical shape than men (Arganini Claudia *et al.*, 2012; Wardle *et al*., 2004). Moreover, it has been acknowledged that fatty rich foods high in saturated fat and trans fat were correlated with the higher risk of developing type 2 diabetes (Van Dam *et al*., 2002).

Although there were no anthropometry measurement within this study, including height and weight data, another plausible reason was might be due to excessive body fat and central obesity in men than women. Men seem to be more susceptible than women to the consequences of obesity due to differences in insulin sensitivity and regional fat deposition (Gale *et al*., 2001). Other mechanism that might be proposed to explain this hyperglycemia condition is the smoking habit among Indonesian which was more prevalent in male population (64.9%) compare to female (2.1%) (Ministry of Health, 2013). Indonesian Ministry of Health reported that along the years from 1995 to 2013, there was an increasing number of Indonesian people above 15 years old who has smoking habit, from 27.2% in 1995 to 36.3% in 2013 (Ministry of Health, 2015) with the average amount of cigarettes used was around 12.3 cigarettes per day. Several reports have shown that smokers are 30-40% more likely to develop type 2 diabetes than nonsmokers and diabetic patients who smoke are more likely than non-smokers to have problem with insulin dosing and to manage their diabetes status, including complication problems. The more cigarettes, the higher the risk for type 2 diabetes development (Department of Health and Human Services, 2015). As the bottom line, smoking habit contributes to more difficulties in managing diabetes status, both for type 1 and type 2 diabetes (Department of Health and Human Services, 2015).

Age: Overall, this study found that the older the age group, the bigger the prevalence of having random blood glucose level >200 mg/dL with the highest prevalence is in 58+ age group around 12.9%. The same pattern also reported in data from 2013 National Basic Health Research which showed that the prevalence of diabetes cases in Indonesian people is increasing along with the increase in age (15-74 years) as shown in Table 4.

One study stated that respondents in 60-85 years age group was having lower insulin secretion in comparison with the younger age group, thus will increase further risk of type 2 diabetes development (Diabetes Prevention Program Research Group, 2006). Furthermore, within this study, the younger age group was also found to have high prevalence of hyperglycemia (3.3% for 28-37 years age and 7.6% for 38-47 years age group). The same finding was also reported by Cali and Caprio (2008) which stated that prediabetes and type 2 diabetes in youth was an emerging epidemic disease, due to the increase in youth obesity (Cali and Caprio, 2008). Youth obesity are

Table 5: Cross analysis of community type and age

	Age													
	----- ≤17 -----		---- 18-27 -----		---- 28-37 ------		---- 38-47 -----		---- 48-57 -----		------ ≥58 ------		---- Total ----	
Group category	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Residential based	3	2.4	20	16.1	5	4	11	8.9	32	25.8	53	42.7	124	100
Office based														
Government	0	0	5	8.3	26	43.3	15	25	14	23.3	0	0	60	100
Media	0	0	6	15	22	55	11	27.5	1	2.5	0	0	40	100
Service	0	0	28	18.5	69	45.7	41	27.2	12	7.9	1	0.7	151	100
Manufacture	0	0	44	25.6	55	32	48	27.9	24	14	1	0.6	172	100
Healthcare facility based														
Hospital	2	0.5	22	5.3	32	7.8	50	12.1	133	32.3	173	42	412	100
Primary healthcare	0	0	4	0.8	6	1.2	73	15.1	132	27.3	268	55.5	483	100

closely linked to the concomitant insulin resistance/ hyperinsulinemia (Cali and Caprio, 2008), hence this issue is an alarming to be addressed immediately. On the other hand, older adults are at high risk for the development of type 2 diabetes due to the combined effect of increasing insulin resistance and impaired pancreatic islet with aging, which are primarily associated with adiposity, sarcopenia and physical inactivity and lead to impaired fasting glucose (Chang *et al*., 2003; Amati and Francesca, 2009). These conditions have been acknowledged in several epidemiological studies (Sinclair and Finucane, 2001). Therefore, lifestyle modification in the older age group with a physical activity addition should be encouraged (Knowler *et al*., 2002).

Community type: From the statistic analysis in this study, it was reported that random blood glucose serum level distribution was the highest in healthcare facilities based setting community, mainly in primary health care (13%). The major members of this community setting were population concerned with health issue, e.g., diabetes and diabetic patients, thus this explained the high prevalence of hyperglycemia within this community setting. Within this community setting, routine activities were performed regularly, such as exercise and physical activities (gymnastics), health workshops and seminars and other type of activities which supported the health improvement program, such as routine blood glucose checking. After performing cross analysis from age and community type variables, Based on the calculation, it is known that within this healthcare facilities, the majority population was 58+years group (49.3%) as shown in Table 5 consists of around 55.5% in the primary health care and 42% in the hospital. Therefore, it will increase the probability to discover hyperglycemia incidence, because diabetes prevalence is increase along with the increase in age (Chang *et al*., 2003; Sinclair and Finucane, 2001; Scheen, 2005; Choi and Shi, 2001). Moreover, this finding also may be explained with the fact that the majority of this community was diabetic patients. For diabetic patients, management of blood glucose serum in a normal range is also strongly recommended, in order to reduce the risks of diabetes complication development (American Diabetes Association, 2014, 2015). One of the strategies to improve life quality of diabetic patients is to discover social support from family, friends, or community (Diabetes Prevention Program Research Group, 2006). Data from previous research have shown that those who are at risk of developing diabetes or those who present with diabetes will have a health status improvement after joining the diabetes community (World Health Organization, 2015). This may due to the interventions given within the diabetes community, for example in the study conducted over a span of 6 years in Alberta First Nation communities, there were several interventions given, such as health and nutrition education on diabetes and community based care with mobile clinic to 43 Alberta First Nation Communities in 2 years. Medical examination was also given, including diabetes complication screening, examination of BMI, waist circumference, HBA1c, total cholesterol, blood pressure, kidney disorders and feet infections. These examinations were monitored and viewed regularly in order to improve the communities health status (Oster *et al*., 2010). Another program designed by WHO, entitled HIA (Health Impact Assessment) has also stated that one factor to influence health status is a social support networks which means greater support from families, friends and communities. This social supports are acknowledged to link to a better health (World Health Organization, 2015).

The second highest prevalence of hyperglycemia was found in residential based setting community, accounted for 12.9% as shown in Table 3. The majority member of this community was respondents who lived around and involved in the activities around the residential area. Based on the cross tab analysis with age variable, there was a similarity characteristic with the healthcare facilities based setting community, which were older age group respondents as the majority (42.7% population was 58+year group) as shown in Table 5. Therefore, it will increase the probability of finding hyperglycemia cases within this community type setting. This finding is supported by 2013 National Basic Health Research which stated that urban population was tended to have hyperglycemia (2.5%) while its counterpart, rural

population was only 1.7% (Ministry of Health, 2013). Another study in India also showed that diabetes cases were reported more prevalent in urban population with odds ratio 7.3 times higher compare to non-urban population (Mohan *et al*., 2008). The proposed mechanism to explain this phenomenon is urban lifestyle which is more related to sedentary lifestyle and physical inactivity (Ramachandran *et al*., 1999). Another study has also reported that exposure to urban population lifestyle may lowered health quality, not only in glucose level but also BMI and blood pressure, significantly (Sobngwi *et al*., 2004). Higher distribution of hyperglycemia status in urban population is considered as one main factor contributing to the increasing number in prevalence of type 2 diabetes in the future. This is in line with the prediction model of global prevalence of diabetes, which stated that in 2030, it is projected that there may be a massive increase up to 2-fold of diabetes cases in the urban population, mainly in developing countries and in the age group above 65 years old (Wild *et al*., 2004).

For office based setting community, the high prevalence of hyperglycemia status was the most visible in media based office (12.5%), the highest among the other offices. High prevalence of hyperglycemia in media based office might be due to high amount of work hours and the tendency to work in night shift. This is consistent with the finding in UK, stated that journalist were having a considerably longer working hours (39.4 h) in comparison with the average working hours in UK (33 h) (National Council for The Training of Journalists, 2013) although in Asia, the average working hours was longer such as 49.6 h/week in Hong Kong (Welford, 2008). In India, it is found that in the news sections, journalist have to work longer hours and have to run around much more (AJF Asia Pacific, 2015). Longer hours of works were correlated with lower health status of employees, such as suffered stress and lack of physical activities (Oyama *et al*., 2012) which was associated with development of hyperglycemia status. According to the cohort retrospective study in Japan, it is known that employees who work in the night shift were significantly having an increase risk of developing type 2 diabetes 2.62 times higher than a non-shift employees (Oyama *et al*., 2012). Additionally, sedentary lifestyle, obesity and unhealthy behaviour may also contribute to development of type 2 diabetes within this population Frank *et al*., 2001).

Hyperglycemia status, if appears persistently in office based setting community may affect employee productivity, evaluated from presenteeism and absenteeism rate. Employees with diabetes status has significantly lower productivity (5-6%) in comparison with the normal employee, both for male and female employees as reported in the study performed by Kaan Tunceli *et al*. (2005). Therefore, as an organization, there is an urgent needs to develop a more organized and integrated wellness plan for its employees.

Strengths and limitations: The measurement of blood glucose serum within this study was performed using random blood glucose principal. Therefore, the impact of this method could not be justified as an indicator for diagnosing diabetes status of the respondents. Based on this limitation, respondents may only be classified as individual with blood glucose above 200 mg/dL (hyperglycemia) and under 200 mg/dL.

Based on the analysis method, this study was merely showed the magnitude of problem through the prevalence of high blood glucose serum and its distribution in another variable such as group category, sex and age. The analysis method could not provide neither the association or explain the cause-effect relation of the problem. Another limitation of this study was the number of samples missing from the initial population due to the incompleteness of the data. However, the study still consisted of large number of respondents as the representatives of each community type.

Despite the limitation of this descriptive study, the finding may provide the tendency or trend which may be used to initiate the hypothesis formulation that can be tested in future analytical study. Additional benefit of this study was the novelty as a pilot study which has provided the blood glucose serum distribution among three different major communities based setting in Jakarta.

Conclusion and recommendation: This study found that the prevalence of random hyperglycemia status (random blood glucose check above 200 mg/dL) in the study population reached 8.9%. From this study, the mapping of random blood glucose serum distribution was also evaluated within each community type. Within all communities type, hyperglycemia status was still found, with the highest was in primary health care community based setting, followed by residential based community setting and office based community. Among office based setting community, media office was reported to have the highest prevalence of hyperglycemia status.

Based on this pilot study, we hope future research may investigates the role of risk factors related to diabetes type 2 development within those three communities type. This is important to create a holistic and integrated intervention strategy which may be correctly designed and implemented to reduce the increasing number of high blood glucose serum within the population. Furthermore, the initiatives created should be the responsibility of all stakeholders, not only the consumers but also the universities, industries, as well as government in order to contribute to healthier Jakarta and Indonesia.

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