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Comparison of Physical Performances with Cognitive Functions and Fear of Falls among Elderly with and without Diabetes Mellitus

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Abstract
Diabetes elderly may experience fear of falls, poor balance and weaker lower limb strengths. The tasks to complete in their daily activities will become very challenging. Therefore, this study aims to compare the physical and cognitive functions towards fear of falls among 80 community-dwelling elders with and without diabetes mellitus. The findings revealed that diabetes elderly would affect their cognitive functions, high risk of falls and reduced their physical activities. Conclusion, the strengths and balances components need to be included in their daily exercise regime to reduce the risk of falls as well as improves cognitive functions.

Keywords: Diabetes; Elderly; Fear of falls; Physical performances

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1.0 Introduction

Falls in the elderly are a significant public health dilemma and it impact on physical and psychological function towards an elderly. This includes injuries, hospitalization and institutionalization (Reelick, van Iersel, Kessels, & Olde Rikkert, 2009), loss of muscle mass and strength, (IJzerman et al., 2012) poor balance confidence (Schinkel-Ivy, Inness & Mansfield, 2015) and fear of falls (FOF) (Jung, 2008). All this may result in activity limitations and reduced their overall quality of life (Reelick et al., 2009; Toebes, Hoozemans, Furrer, Dekker, & Van Dieën, 2015).

The most significant predictors that related to falls in the elderly are balanced abilities, fear towards fall and lower limb weakness. The previous study has revealed that ability to maintain balance while in movement during activities of daily living or multitasking was declined with age (Ghanavati, Shaterzadeh Yazdi, Goharpey, & Arastoo, 2012; Reelick et al., 2009). Elderly with poor balance control contributed to a decrease in walking velocity and step width as well as declining in the movement of the hip and ankle joints. This may lead to gait difficulties and increase the risk of falls (Lim, Kim, Noh, Yoo, & Moon, 2014).

An elderly who experienced falls may develop fear towards recurrent falls. It is a primary psychological syndrome that occurs, due to the impact of multiple histories of falls (Kumar, Carpenter, Morris, Iliffe, & Kendrick, 2014). The effect of this syndrome will lead to decline quality of life consequently make the elderly become weaker, more frailty and developing muscle atrophy (Tander et al.,2016). In addition to that multiple falls eventually grew anxiety feeling and lack of balance confidence result in future high fall risk (Lee, 2013). Considering the more significant characteristic in activity in the community, it was surprising that the majority of the elderly will declined in all activities of their daily living.

Addition, a weak lower limb strength in elderly will creates an unsafe walking pattern and high risk of fall. Decreased motor unit properties such as reduced in satellite cell and fibre numbers an sizes will be experienced through advancing age (Papa, Dong, &

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Hassan, 2017). All these changes may lead to skeletal muscle functions impaired and the main contributors to falls in the elderly (Reelick et al., 2009; Vinik, Vinik, Colberg, & Morrison, 2015). In comparison to that, those elderly with diabetic will demonstrate with accelerated decline in lower limb strength and increased FOF indicating them predisposing to falls (IJzerman et al., 2012)

Diabetes is a chronic disease involved in insulin production, whether it does not produce enough by pancreas or body cannot effectively use the insulin produced (Kirkman et al., 2012). Increasing trend of prevalence of diabetes to be said high among the elderly population (Chiba et al., 2015; Tee & Yap, 2017). Diabetic is related to peripheral neuropathy which is a common complication of microvascular disease faced by long-term diabetic people (P & S, 2017; Tilling, Darawil, & Britton, 2006; Timar et al., 2016). Diabetes can cause retinopathy, renal failure, cardiovascular disease, decline quality of life, and primary contributor to non-traumatic amputation (Lim et al., 2014; Moreira et al., 2017; Tander et al., 2016).

Elderly with diabetic peripheral neuropathy (DPN) is highly associated with gait and balance deficits which then contribute to higher risk of falls as to compare to that without neuropathy (Hewston & Deshpande, 2016; Yeong, Tan, Yap, & Choo, 2016). In another study by Lim et al. (2014), found that DPN is causing lack of somatosensory and impaired proprioception leading to balance instability. The prevalence of diabetic complications probably can explain the increased FOF, excess balance and mobility impairments, and also accelerated the loss of muscle mass and strength (Kelly et al., 2013).

Previous studies demonstrated that poor functional performance and increased FOF leading in a higher risk of falls in elderly with diabetes (Afridi, 2015; Pinheiro, Vilaça, & Carvalho, 2014; Reelick et al., 2009; Tander et al., 2016). However, another study has not discussed on a comparison of muscle strength along with functional performance and FOF in community-dwelling diabetic elderly with health one. Therefore, this study has been designed to compare balance performance, lower limb strength, and FOF in community-dwelling elderly with and without diabetes. Furthermore, this study evaluating the effect of diabetes and cognitive status among diabetic elderly on muscle strength functional performance.

2.0 Literature Review

Fear in the elderly can cause many consequences such as high fear of fall, which can lead to physical inactivity and further mortality. Fear generally can be defined as emotion in terms of being created by particular designs of threat-related stimuli, and in turn causing specific configurations of adaptive behaviours to elude or manage with that risk (Adolps, 2013). There are different concept of fear that was previously proposed: (1) is a biologically primary emotion to human and other animals (Ekman, 1992) (2) fear emotion should be exchanged by a otherness between a fear and a panic structure (Panksepp, 1998) (3) the 'survival circuits' related more broadly to adaptive behaviour (LeDoux, 2012), or dimensional accounts such as incentive and penance (Rolls, 1999). The most common is fear and anxiety, but both of the emotion is relatively different because it occurs in a different structure. A review by Adolph (2013) stated that fear and anxiety is a diverse as the fear is adaptive, but temporary state caused by an opposition with a threatening stimulus while the anxiety is more tonic state related to guess and alertness. Besides, Gross and Canteras (2012) believed that there are various fear circuit tangled fear of pain, predators and hostile conspecifics occur. Therefore, all of this evidence supports the concept of the fear itself.

Most of the elderly with FOF having a history of falls more than once, taking more medications and poor health status. A study by Malini, Lourenço, & Lopes (2016) showed that the increment on the prevalence of FOF among the ageing population positively increases. The results stated that diabetic group scores low mFES than the non-diabetic group. Diabetic elderly tend to have inadequate glycaemic control resulting in progressive deterioration of sensory nerve fibres in the somatosensory system (Tander et al., 2016). To maintain balance and avoid falls, diabetic people will increase in anxiety and FOF, during functional activity (Hewston & Deshpande, 2018). This situation will put an extra burden on them.

FOF was associated with duration since diagnosis of diabetes which also similar to previous research (P & S, 2017; Tander et al., 2016) and in this present study came to agree with this. Increase in duration of diabetes will lead to many complications to elderly such as peripheral neuropathies (Nisar et al., 2015), impaired psychological status (Saedi, Gheini, Faiz & Arami, 2016). Giacco & Brownlee (2010) proposed that long-term hyperglycemia influenced the changes in the brain structure affecting cognition and may increase the risk of anxiety and fear of falls in elderly with diabetes.

3.0 Methodology

The current study was a cross-sectional descriptive study aimed to compare the balance performance, lower limb strength and FOF in elderly with and without diabetes. The research was done in Kampung Bukit Cherakah, Kuala Selangor, Malaysia. A total of 80 elderly above the age of 60 years were divided into two group of 40 diabetic and 40 non-diabetic subjects. The study was conducted after the Research Ethics Committee has approved the ethics and all subjects were given written informed consent. The subjects were screened for eligibility before being included in the study.

All subjects were questioned about their demographic and medical status. Also, the subjects also were asked on the history of falls, the level of FOF and number of falls in the past 12 months. In the diabetic group, the data about the duration of years since diagnosis, the presence of neuropathy and the use of medication for diabetic treatment were recorded through the subject's medical records.

Other inclusion criteria were included; age 60 years or older, able to tolerate and understand instructions and an independent. Subjects were excluded if they had a neurological disorder that influenced gait, chronic respiratory and cardiac disease, had severe hearing and visual impairment and diagnosed with severe cognitive impairment by a neurologist and unable to follow the command.

3.1 Instruments

Balance performance was tested using Timed-Up and Go test (TUG). The test is used to assess the subject's mobility requiring both static and dynamic balance (Shumway-Cook, Brauer, & Woollacott, 2000). The time to complete the task was taken. The subjects were instructed to stand up from the chair, walk for 3 meters, turn and walked back to sit on the chair. The TUG test consists of three tasks where the regular walk for 3 meters is a TUG-Single task. The tug-dual task needs the subject to carry a glass of water, while in TUG-Cognitive, the subject required to count the number backwards. During the performance, subjects should wear their regular footwear and uses any mobility aid they regularly used. It has been suggested that elderly with longer TUG times are more likely to have a fall risk than those with shorter time (Kear, Guck, & McGaha, 2017).

Modified Fall Efficacy Scale (mFES) was used to measure the FOF. It is a self-reported questionnaire that assesses the level of concern about falls during daily activities. There are 14 simple activities at home in the questionnaire. A higher score reflects more confidence, less FOF, and lower score reflect less confidence and more FOF. Each of the activity was rated with a 10-point scale of fear. The total scores are140 and will divide into ten ratings. Therefore, the scores with < 8 indicates greater FOF, while 8 or > 8 is lack of fear (Hill, Schwarz, Kalogeropoulos, & Gibson, 1996).

To assess lower limb strength, the 30-second Chair Rise test (CRT) is used. The subjects were instructed to sit on a chair without armrest on flat ground and with arm folded across the chest. In 30 seconds, the subjects need to be sat on and stood up from the chair repeatedly, while the researcher measured the number of repetition the subjects have seated down. The lower the number of repetition the subjects have been seat indicates reduced lower limb strength (Contro et al., 2012).

3.2 Statistical analysis

Data analyses were performed using SPSS version 22.0. Normality distribution of data was tested using the Shapiro-Wilk test and assumption of all quantitative outcomes are not normally distributed. Descriptive data were presented as a median ± interquartile range (IQR). Chi-square test was used to compare the categorical data of demographical characteristics between the diabetic and non-diabetic group. Mann-Whitney U test was used to compare the binary outcomes variables between the two groups. Meanwhile, Spearman's correlation coefficient analysis was used to investigate the correlations between the outcomes variables. The sample size estimation was calculated using G Power 3.0 software. In order to have a statistical power of 0.90, and an alpha of 0.05, it was estimated that 80 total subjects in each group were required to detect the differences between the groups.

4.0 Findings

The demographic characteristics for elderly with diabetic status are summarised in Table 1. The median age of the elderly in this study was 62 (± 11) years. Regarding diabetic status, the median time since diagnosis was 11 (± 7) years. The percentage of the elderly with the diabetic peripheral neuropathy (DPN) was 40% indicating that less than half diabetic elderly experiencing impaired sensation. All elderly in the diabetic group reported with use of medication such as oral hypoglycaemic agent and insulin for diabetic treatment.

Table 1: Demographic Characteristics of Diabetic Group (n=40)

Characteristics	n	%	Median	IQR	Min-Max
Age (years)			62	11	60 - 83
Times since diagnosis (years)			11	7	3 - 25
DPN	16	40			
Use of medication	40	100			

Abbreviations: IQR=Inter-quartile range, n=number of subjects, DPN=Diabetic peripheral neuropathy.

The total number of 80 elderly was divided into 40 diabetics and 40 non-diabetic subjects. Comparison of demographic details of diabetic and non-diabetic groups are shown in Table 2. Based on the result, there are no significant differences found regarding sex, marital status, level of education, the presence of hypertension, use of walking aids and history of falls between diabetics and non-diabetics ($p > .05$).

Use of medication is more prevalent in the diabetic group compared to the non-diabetic group with 40 (100%) and 14 (35%), respectively. This result shows that all diabetic elderly does depend on medication to keep their blood sugar level under control ($p < .001$). Besides, there is no poor health status among the elderly in both groups ($p = .015$). Most of the diabetic group have fair health than the good health status with 33 (82.5%) and seven (17.5%), respectively. All elderly could perform the assessments with supervision only. Nine diabetic elderly (22.5%) did use walking aids more than the non-diabetic group with only four elderly (10%). In the diabetic group, 14 (35%) elderly reported with a history of falls in the previous 12 months, while there are nine (22.5%) involve with falls in non-diabetic groups. But there is no significant difference reported on walking aids and history of falls in both groups ($p = .217$).

In contrast, FOF which demonstrated in both diabetic and non-diabetic group, have a significant difference as it appears high in the diabetic group ($p = .043$). There are 27 (67.5%) experiencing FOF in diabetic group compared to the non-diabetic group with only eighteen (45%). Based on the level of FOF, the highest FOF dominated by a diabetic group with five elderly (12.5%) as the non-diabetic group is only three elderly (7.5%). But 47.5% of the rest in the diabetic group have regular FOF, while the most of non-diabetic group experiencing less FOF with 40% of them.

Table 2: Comparison of Demographic Details of Diabetic and Non-Diabetic Group (n= 80)

Characteristics	Category	Diabetic group (n=40)		Non-diabetic group (n=40)		P value
		n	%	n	%	
Sex	Male	17	42.5	22	55.0	.263
	Female	23	57.5	18	45.0	
Marital	Married	29	72.5	31	77.5	.606
	Widowed	11	27.5	9	22.5	
Education	No school	10	25.0	6	15.0	.417
	Primary school	14	35.0	15	37.5	
	Secondary school	13	32.5	18	45.0	
	University	3	7.5	1	2.5	
Use of medication	Yes	40	100	14	35.0	.000*
	No	0	0	26	65.0	
Presence of hypertension	Yes	9	22.5	16	40.0	.091
	No	31	77.5	24	60.0	
Health status	Fair	33	82.5	23	57.5	.015*
	Good	7	17.5	17	42.5	
Use of walking aids	Yes	9	22.5	4	10.0	.130
	No	31	77.5	36	90.0	
History of falls	Yes	14	35.0	9	22.5	.217
	No	26	65.0	31	77.5	
Presence of FOF	Yes	27	67.5	18	45.0	.043*
	No	13	32.5	22	55.0	
Level of FOF	Less	2	5.0	16	40.0	.003*
	Normal	19	47.5	12	30.0	
	Moderate	14	35.0	9	22.5	
	Very	5	12.5	3	7.5	

*Abbreviations: FOF= FOF, * p-value is significant when <0.05*

A summary of the results of each outcome measure can be seen in Table 3. The results will use the non-parametric test as most of the data were non-normally distributed. For this comparison results, the data were analysed using the Mann Whitney U test.

Table 3: Comparison of variables between Diabetic and Non-Diabetic Group

Variables	Diabetic group (n=40)		Non-Diabetic group (n=40)		P value
	Median	IQR	Median	IQR	
mFES	92.50	30	107	48	0.001*
30 Sec CRT	12	5	14	5	0.191
TUG-Single task	11.36	2.98	9.15	4.41	0.075
TUG-Dual task	24.49	19.81	24.79	20.11	0.070
TUG-Cognitive	12.97	3.40	10.29	5.16	0.050

*Abbreviations: mFES= modified falls efficacy scale, CRT=Chair rise test, TUG= time up-and-go test, * p-value is significant when <0.05*

MFES was used to estimate FOF, with lower scores representing greater FOF. The median score on the mFES in diabetic group was 92.50 (± 30) lower than in the non-diabetic group with 107 (± 48). Based on the result, it can be concluded that mFES in the diabetic group were statistically significantly lower than the non-diabetic group, p = .001.

Lower limb strength was analysed using 30 seconds chair rise test (CRT). The results show that the diabetic group had a small number of times of 12 (± 5), while the non-diabetic group sometimes had 14 (± 5). However, there are no significant differences statistically in both groups, p =.191.

The TUG-Single task required the elderly to concentrate on one work only. The TUG-Single task took the shortest amount of time with a median of 11.36 (± 2.98) seconds in the diabetic group. While in the non-diabetic group the time to complete the TUG-Single task was 9.15 (± 4.41) seconds. The analysis of data shows that there was no significant difference between those two groups, p = .075. However, the trends were there whereby the diabetic groups may require a specific time to complete the task compared to another group.

The TUG-Dual task took longer to complete than the TUG-Single task because the elderly need to focus on two tasks. They need to walk with balance care while carrying a glass in one hand. The median time to complete TUG-Dual task in the diabetic group is 24.49 (± 19.81) seconds as to compared with the non-diabetic group with a median time of 24.79 (± 20.11) seconds. The result shows that there was no significant difference between those two groups (U = 611.5, p = .070).

The TUG-Cognitive is a task that needs the elderly to count number in backward while walking and maintaining balance. In the diabetic group, the TUG-Cognitive task took the longest with a median of 12.97 (± 3.40) seconds while the non-diabetic group with an average of 10.29 (± 5.16) seconds. As refer to Table 3, it can be concluded that TUG-Cognitive in the diabetic group was not a significant difference than the non-diabetic group (U = 596.5, p = .050).

The correlation results were investigated using Spearman's correlation coefficient. The results can be seen in Table 4. Spearman's correlation coefficient results showed that mFES scores had a strong significant negative correlation between age, DPN, history of falls, level of FOF, TUG-Single task, TUG-Dual task, and TUG-Cognitive task (p < .001). It indicates that as the mFES scores are lower while the other variables will be increased. On the other hand, mFES had a positive correlation with 30 seconds CRT (p < .001). It means, the lower the mFES scores, the lower limb strength would be.

The correlation between lower limb strength and balance performance is shown in Table 4. The results show a moderate negative relationship between 30 seconds chair rise test CRT with age, DPN, history of falls, level of FOF and mFES (p < .001). While there is a strong negative correlation between 30 seconds CRT with TUG-Single task, TUG-Dual task, and TUG-Cognitive task (p < .001), indicating reduced in lower limb strength will reduce the balance performance.

Both TUG-Single and TUG-Dual task had a strong correlation with TUG-Cognitive, MFES scores, 30 seconds CRT, level of fear and history of falls (p < .001). Meanwhile, the Spearman's correlation coefficient results showed that TUG-Cognitive task had a strong correlation with TUG-Single, TUG-Dual task, mFES scores, level of fear, and lower limb strength (p < .001). It indicates that the worse cognitive status, the worse balance performance, lower limb strength, and FOF.

Table 4: Spearman correlation coefficient of the variable

Age	r	.486	.063	.392	-.316	-.303	.374	.386	.437
	p	.000	.581	.000	.004	.006	.001	.000	.000
DPN	r	1	.304	.441	-.388	-.224	.313	.334	.395
	p		.006	.000	.000	.046	.005	.002	.000
HOF	r		1	.505	-.466	-.388	.431	.447	.441
	p			.000	.000	.000	.000	.000	.000
FOF	r			1	-.799	-.592	.706	.714	.714
	p				.000	.000	.000	.000	.000
MFES	r				1	.539	-.794	-.799	-.775
	p					.000	.000	.000	.000
30 sec CRT	r					1	-.730	-.688	-.659
	p						.000	.000	.000
TUG-single task	r						1	.969	.965
	p							.000	.000
TUG-Dual task	r							1	9.59
	p								.000
TUG-Cognitive	r								1
	p								

Abbreviations: r=Spearman's correlation coefficient, DPN= Diabetic peripheral neuropathy, HOF= History of falls, MFES= modified falls efficacy scale, CRT=Chair rise test, TUG= time up-and-go test, the p-value is significant when <0.05

5.0 Discussion

From the present study, the aim is to compare the balance performance, lower limb strength, and FOF in community-dwelling elderly with and without diabetes. This study was also evaluating the effects of diabetic and cognitive status on lower limb strength, balance performance, and FOF in community-dwelling elderly. Thus, it is understandable that this study shows increased FOF, worse balance performance and poor lower limb strength, especially with cognitive task included, in elderly with diabetic compared to non-diabetics.

Previous studies have demonstrated that peripheral neuropathy and FOF are linked to changes in gait performance (Kelly et al., 2013; Moreira et al., 2017; Tilling et al., 2006) and the present findings are in good agreement with these. As blood glucose level rise, the biochemical abnormalities will cause changes in protein glycation and elevate the level of reactive oxygen species, so this will lead to vascular damage (Paneni, Beckman, Creager & Cosentino, 2013) and impaired somatosensory system (Giacco & Brownlee, 2010). For that reason, lack of sensation might reduce gait performance and increased FOF. However, a study by Kelly et al. (2013) found that among elderly with and without DPN, FOF and DPN are not correlate well.

Apart from that, there is a strong correlation between a history of fall and FOF (Chang, Chen, & Chou, 2016; Lee, 2013). Throughout this study, 28.8% of elderly declared to experience multiple histories of falls. History of falls affecting leg strength, functional task, and FOF, have been widely reported in previous studies (Ambrose, Paul, & Hausdorff, 2013; Chang et al., 2016; Kenny, Romero-Ortuno, & Kumar, 2017; Moreira et al., 2017). Many elderly experiencing falls more than one will have psychological consequences due to trauma. In the current study, FOF does related to the history of falls within last year whether in diabetic or non-diabetic elderly.

With advancing age, elderly with increased FOF will have worse balance performance (Gazzolaa, Perracini, Ganançac & Ganançad, 2006). There are many studies reported the association between FOF and balance performance among elderly (Ambrose et al., 2013; Dionyssiotis, 2012; Reelick et al., 2009). This is because an existing FOF have developed anxiety in the elderly and then influence the attentional processes required while maintaining balance performance. The changes in the allocation of attention will alter the motor control, hence presented with poor balance performance (Young & Mark Williams, 2015). According to the results of our study, the FOF using mFES was correlated with TUG task, the measure for balance performance and this finding was consistent with other studies (Moreira et al., 2017; Tander et al., 2016).

Many studies reported that diabetic elderly does associate with poor muscle strength as compared to the healthy group (Leenders et al., 2013; Seok Won Park, Goodpaster, Strotmeyer, De Rekeneire, et al., 2006). However, there is no significant difference in the repetition of chair rise test. The results were somewhat surprising because people with diabetes had been known to have weaker and poor muscle strength (Leenders et al., 2013). This may be because the subjects in this study have less disease severity and complications. Previous studies have demonstrated that loss of muscle mass and strength recorded in diabetic people, was greater with longer diabetes duration and more severe (IJzerman et al., 2012; Seok Won Park, Goodpaster, Strotmeyer, de Rekeneire, et al., 2006; Van Sloten et al., 2011).

Furthermore, longer duration of diabetes with many complications also correlated with poor quadriceps strength in people aged 60 years and above (Kalyani et al., 2013). A study by IJzerman et al., (2012) proposed that the development of insulin resistance in diabetic people causing abnormalities in lower limb muscle metabolism. The same author claimed that approximately 30% to 50% maximal muscle strength reduced, in the lower limb, due to the effect of insulin resistance. Studies by Morcelli et al., (2016) and Power et al., (2013) revealed that decrease in muscle capacity regarding a reduction in muscles power and torque rate, and decrease muscle initiation due to morphological alterations in the muscles.

Some authors defined, with advancing age in diabetic elderly, the leg strength become worsen, impaired balance performance and increased FOF leading to risk of falls (Pinheiro et al., 2014; Toebes et al., 2015) and reduced quality of life (IJzerman et al., 2012; Seok Won Park, Goodpaster, Strotmeyer, de Rekeneire, et al., 2006). People with multiple histories of falls also associated with weak leg strength due to impaired psychological status whether in the diabetic or non-diabetic group. Falls experienced eventually lead to poor balance (Ambrose et al., 2013; Hewston & Deshpande, 2016) and loss of muscle strength (Moreira et al., 2017; Tander et al., 2016) due to less mobility among diabetic elderly.

The study shows that diabetic elderly took longer to complete TUG for all task. A previous study by Chiba et al. (2015), agree that poor glycaemic and psychological status among diabetic elderly may lead to poor balance then consequently increased risk of falls and enhanced FOF. The reason there is no statistical difference in both group is likely because there are less diabetic elderly in the study which experiencing neuropathy and other complication of diabetes. The previous study reported that foot deformity and neuropathy could lead to alteration of foot posture (Hastings et al., 2015), resulting in impaired balance and gait thus, reduced walking velocity (MacGilchrist et al., 2010). It is believed that the more severe diabetes, the more challenging to complete the task.

The study found that less mobile people with lower functional ability are more afraid of falling (P & S, 2017; Thiamwong & Suwanno, 2017). However, it is known that the FOF leads to functional decline (Young & Mark Williams, 2015) thus it would be another reason for FOF led to the restriction of the practical task in the study. Studies reported that less functional mobility in daily activities associated with reduced muscle strength either in the diabetic or non-diabetic group (De Villiers & Kalula, 2015; Leenders et al., 2013; Schaap, Koster, & Visser, 2013), similar to this study. Nonetheless, diabetes might worsen the muscle strength due to weak balance impact (IJzerman et al., 2012).

It was reported in research by Alvarenga, Pereira, & Anjos (2010) that diabetes associated with the TUG-Dual task. But it was found that in this current study, there is no significant difference between both groups. It might be due to the subjects in the survey have less disease severity and complications. Unlike in study by Rucker, Jernigan, McDowd, & Kluding (2014) and Sertel et al. (2017) reported that reduction in performance among diabetes group related to the concentration required by elderly to complete dual-task at once. Kelly et al. (2013) claimed that the capacity theory proposes when individual performing dual-tasks there is competition for information processing, which can result in a reduction of performance in one or both tasks.

TUG-Cognitive task poses a challenge to attentional abilities by elderly where the central mechanism which is the prefrontal cortex activity and executive functions influenced (Al-Yahya et al., 2011). Similar to the result of previous research (Alvarenga et al., 2010; Rucker et al., 2014; Sertel et al., 2017) it showed the statically significant difference between both groups, where elderly diabetic showed worse performance and took longer time in completing the task. Additionally, this study showed impaired cognitive status higher in diabetic elderly as compared to non-diabetics. The greater cognitive decline over longer duration since diagnosis of diabetes and poor glycaemic control. A study by Kim & Feldman (2012) believed that insulin regulates neurons in the central nervous system. Previous studies demonstrated the roles of diabetes in affecting cognitive status may lead to slower gait, delayed performance and an elevated risk of falls (Cukierman, Gerstein, & Williamson, 2005; Roman de Mettelinge, Cambier, Calders, Van Den Noortgate, & Delbaere, 2013; Sims-Robinson, Kim, & Feldman, 2014).

It's been revealed throughout the study that cognitive status influenced the performance of balance and lower limb strength. Yogev-Seligmann, Hausdorff, & Giladi (2008) stated that performance of walking depends on cognitive converting, executive functions and consideration of individuals. Since cognitive status and diabetes are correlated with FOF, balance performance and muscle strength, our study suggests that diabetic elderly with the cognitive problem are more likely to have balance disturbances, weak muscle strength, increased fear, and fall risk. Long-term hyperglycemia eventually increased oxidative stresses that can damage neurons leading to cognitive impairment (Giacco & Brownlee, 2010). Al-Yahya et al. (2011) demonstrated that gait performance with cognitive task required great attention ability especially in elderly with diabetes.

There has been a perspective on cycle effects of falls (Lavedán et al., 2018). Elderly who experience a fall before might develop a behaviour of fear towards falls where they believe after suffering one it will increase the risk to have another fall, thus leading to a cyclical effect of falls, FOF, functional performance decline, weak muscle strength and poor health status. Elderly with mental and emotional changes after trauma tend to have low self-efficacy (Simmen-Janevska, Brandstätter & Maercker, 2012) and self-confidence because they believed that avoidance of functional activities could act as falls precaution (Jung, 2008). Hence, the cycle needs to stop to maintain the health status, improved functional independently and prevent any other consequences related to falls in the future, among the elderly.

The main limitation of the study is this study may be lack evaluation of mental status among subjects with and without diabetes. The study only evaluates cognitive status. In this study, the presence of diabetes was only assessed through self-report or by last medical check-up at the hospital instead of using the meter. The severity of diabetes is based on glucose concentration in the body. Other than that, the study does not undergo peripheral nerve test to get accurate neuropathy report. The subjects in the study mostly have a higher socioeconomic background where they have a better total diet quality and partaking in regular exercise. Therefore, there is not much difference seen in between diabetic and non-diabetic group regarding the balance performance for all task.

The strength of the study is that we evaluated cognitive status as contributing factor affecting the balance performance and FOF. Besides, the subjects consist of a healthy, age-matched group of similar features thus there is no significant difference in marital status, occupation, and education, that may lead to an error during data collection. Therefore, it can reduce the bias of the diabetic group experiencing great emotional and mental impaired as their background status is no different to the healthy group. Poor background status may affect the psychological state status of individuals (Singh & Misra, 2009).

6.0 Conclusion and recommendations

In this study, the elderly with diabetic revealed that the elderly would have a high incidence of FOF, more significant in balance impairment and also reduced lower limb strength compared to the non-diabetic elderly. All of the parameters such as the age, duration since diagnosis, history of falls, DPN, level of fear, balance performance and lower limb strength showed positively associated with diabetic elderly concerning the fear of fall. In addition, the completion time for TUG task in diabetic group was significantly correlated with FOF and lower limb strength. Meanwhile, reduce in muscle strength is reported to be lessened balance performance and enlarged FOF in both groups. Based on the study results, the cognitive status of the diabetic elderly showed positively significant towards FOF, lower limb strength, and balance performance.

This present study involves the cross-sectional study that might mislead the results, but it is recommended for future research to gather more participants and differentiate the genders as it can help to identify the gender difference in Malaysia population either. In addition, it is recommended for future studies to involve other races, nationalities and different locations (e.g. institutional) with diabetic to determine their risk of fall and also can make the comparison between in community or institutional. Also, the health care professionals, especially physiotherapists are in the best position to encourage elderly with diabetic to participate in a healthy lifestyle. The physiotherapists also can give a suitable exercise program to that specific level of the elderly diabetic capacity to improve their overall physical and mental functions. Thus, the elderly should aware of factors contributing to falls as a precaution and strategies to avoid the falls consequences. Therefore, these instruments should be considered in investigating the effect of combined exercise program and cognitive behavioural therapy with balance and muscles training in managing people with high FOF and impaired cognitive status.

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