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PHYSICAL ACTIVITY AND QUALITY OF LIFE OF HYPERTENSIVE PATIENTS WITH AND WITHOUT DIABETES: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Physical activity is associated with health-related quality of life in general population with and without chronic conditions, but little is known, whether and how, this relationship exists in hypertensive and diabetes patients, especially in Malaysia. Thus, this cross-sectional study was primarily to determine if and how physical activity was related to hypertensive patients with and without diabetes.

Materials and Methods: The sample consisted of 260 hypertensive patients receiving treatment in Hospital Serdang, Selangor, Malaysia. Participants completed measures of physical activity and quality of life questionnaires. The multiple analysis of covariance was used to examine the effects of physical activity on the quality of life scores.

Result: Subjects were divided into physically active group (n=139) and a physically inactive group (n=121). Of these, 40% were diagnosed without diabetes mellitus and 60% were patients with diabetes. Respondents in the hypertension with diabetes group were older, had lower educational level, and more were unemployed than those hypertensive without diabetes. The quality of life scores were significantly different comparing physically active and inactive subjects. The presence of diabetes contributed to higher differences in quality of life scores. Higher physical activity was positively associated with higher quality of life measures in both physical and mental domains.

Conclusion: Higher levels of physical activity may improve quality of life in both hypertensive patients with and without diabetes. Therefore, incorporating more physical activities into the lifestyle of hypertensive patients, may improve their quality of life and prevent complications.

Keywords: Physical activity, Quality of life, Hypertension, Diabetes, Malaysia

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1.0 Introduction

Hypertension is a common health problem. It affects 1 billion individuals worldwide and 7.1 million deaths annually (Chobanian et al., 2003). Hypertension is the leading risk factor for disease and it is estimated that 4.8 million individuals have hypertension in Malaysia (Ministry of Health Malaysia, 2008). In 2004, 40.5% of Malaysians aged >30 years suffered from hypertension, and only 26.8% of the treated hypertensive patients achieved blood pressure under control (Rampal, Rampal, Azhar, & Rahman, 2008). The Malaysian National Health and Morbidity Survey reported the prevalence of hypertension increased from 30% in 1996 to 43% in 2006. As the prevalence of hypertension continues to increase, improving quality of life in hypertensive patients is an important element in clinical management and research.

Health-related quality of life (HRQoL) refers to the physical, psychological, and social domains of health, seen as distinct areas that are influenced by a person's experiences, beliefs, expectations, and perceptions (Testa & Simonson, 1996). A better understanding of factors contributing to HRQoL may help to develop and apply strategies for health promotion among hypertensive patients. In terms of impact of hypertension on HRQoL, hypertension was found to be significantly limiting daily activity and reducing work performance (Wang et al., 2009). Studies have reported that hypertension altered physical and mental HRQoL (Bardage & Isacson, 2001; Lawrence, Fryback, Martin, Klein, & Klein, 1996; Mena-Martin et al., 2003), with lower SF-36 scores ranging from 1.6 to 9.8 points, when compared with the Malaysian norms. However, bodily pain score was slightly above that of the norms(Khaw, Syed Hassan, & Abd Latiff, 2011).

Physical activity is known to be an important factor to prevent hypertension and decrease blood pressure (Padilla, Wallace, & Park, 2005). Several studies have found that physical exercise was associated with improved HRQoL status in general population (Brown et al., 2003; Pucci, Reis, Rech, & Hallal, 2012; Shibata, Oka, Nakamura, & Muraoka, 2007), and in patients with chronic conditions, such as cancer (Mishra et al., 2012), cardiovascular disease (Taylor et al., 2004), and others. To date, little is known on improvement of specific domains of HRQoL by physical activity in hypertensive patients. An epidemiological study suggested that physically active hypertensive patients showed significantly increased HRQoL scores in physical and psychological functioning (Cuevas Fernandez, Marco Garcia, Rodriguez Alvarez, Iglesias Giron, & Aguirre-Jaime, 2007). More Malaysian adults were leading sedentary lifestyle or lacking in physical activity, and beneficial effects of physical activity in hypertensive patients have been attributed, with evidence, to its impact on HRQoL. Therefore, an understanding of the HRQoL scores and physical activity levels could lead to effective lifestyle interventions to enhance patients' wellbeing.

Hypertension is commonly accompanied by type 2 diabetes mellitus. A prospective study suggested that type 2 diabetes mellitus was nearly 2.5 times more likely to develop in hypertensive individuals than in normotensives (Gress, Nieto, Shahar, Wofford, & Brancati, 2000). Patients who took beta-blockers had 28% greater risk for subsequent development of diabetes mellitus. Liu *et al.*(2013) found that the prevalence of diabetes in hypertensive patients was 24% in China. The prevalence of coexistent hypertension and diabetes was higher in older patients with low educational level, obesity and high triglycerides. Patients with both hypertension and diabetes have twice the risk of cardiovascular disease than in those with hypertension alone.

Diabetes and hypertensive patients were found to be associated with physically inactivity (Gu et al., 2013). Predictors of HRQoL scores may differ in hypertensive patients between those with and without diabetes. Gu *et al.* also reported that low physical activity level, medical comorbidities, and certain demographics factors contributed significantly to decreased HRQoL in diabetes and hypertensive. The primary purpose of this cross-sectional study was to investigate, in a sample of Malaysian hypertensive patients, whether measures of physical activity level are related to HRQoL scores, in patients with and without diabetes.

2.0 Materials and Methods

2.1 Study design

A cross-sectional study was conducted in Serdang Hospital, Selangor, Malaysia. Respondents were recruited from the medical clinic. A total of 260 respondents who had been confirmed diagnosed with hypertension and taking antihypertensive medication at least for 6 months, aged 21 to 80 years old, and able to read or understand the Malay language, were recruited into this study.

The study employed purposive sampling on selected respondents who were outpatients visiting medical clinic for their regular or new medical appointments. All respondents were interviewed, individually, using pre-tested questionnaire. The Ethical Committees of the Ministry of Health, Malaysia and the Faculty of Medicine and Health Sciences, Universiti Putra Malaysia had earlier approved the study. Participation in the study was voluntary.

2.2 Measurements

HRQoL scores were assessed by SF-36, the medical outcome study short-form health survey instrument. The Malay version of the SF-36 employed had proven validity and reliability in individuals and asthmatics, as well as established norms for Malaysian general population (Sararaks et al., 2005). This instrument consists of 36 items that are scored to measure eight domains: physical functioning, role limitations due to physical problems, bodily pain, general health perception, social functioning, role limitations due to emotional problems, vitality, and mental health. Measurement of the SF-36 scores range from zero (0, poorest health) to one hundred (100, optimal health).

Physical activity was measured by using the International Physical Activity Questionnaire (IPAQ) that assesses physical activity in the last seven days (Craig et al., 2003). The IPAQ instrument has been tested, for validity and reliability, across 12 countries. This instrument measures frequency, duration, intensity of physical activity in leisure-time, work, transportation, and doing household tasks. The short version consists of nine items including time spent in walking, vigorous activity, moderate activity, and sedentary activity. Metabolic equivalent tasks (MET) values were computed, and they were categorized into active and inactive groups.

Information was collected on the demographic characteristics of age, gender, ethnicity, educational level, marital status, and working status. Comorbid conditions such as heart

disease, stroke, and nephropathy were determined by carefully asking patients, whether they had ever, or never, been told, by a doctor that they had such conditions, or not.

2.3 Statistical analyses

All analyses were conducted using the IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp., Armonk, NY, USA) and statistical significance level was set at $p<0.05$. Chi-square analysis examined the associations of diabetes mellitus with selected socio-demographic and medical characteristics. In order to determine that measures of HRQoL could be differentiated by physical activity or presence of diabetes mellitus, values for different subscales of the SF-36 were used as dependent variables in a 2 (physical activity) x 2 (presence of diabetes mellitus) MANCOVA (multivariate analysis of covariance); with age, education and complications as covariates. Univariate ANCOVA analysis subsequently factored out HRQoL scores in all eight domains.

3.0 Result

3.1 Characteristics of respondents

Table 1 shows the socio-demographic and medical characteristics of hypertensive respondents by presence and absence of diabetes mellitus. The mean age of the respondents was 57 years. Among the hypertensive, more than half (56.9%) were Malay, 29.2% Chinese and 13.9% Indian. More than half had completed secondary education (54.2%) and 68.8% were currently unemployed. Nearly half of the respondents (57.7%) had their blood pressure under controlled condition (<140/90 mmHg). About 12.3% of the respondents were diagnosed with stroke, 13.5% respondents with heart disease and 28.8% respondents with nephropathy. Among the respondents, 32.2% had normal BMI, 40.8% were overweight and 26.9% were obese. About 46.5% of the respondents were physically inactive while 53.5% were physically active.

Table 1: Characteristics of hypertensive patients

Characteristics	**n (%)**	**Mean (95% CI)**
Age (years)		56.51 (54.90-58.12)
Gender (%)		
Male	110 (42.3)	
Female	150 (57.7)	
Ethnicity (%)		
Malay	148 (56.9)	
Chinese	76 (29.2)	
Indian	36 (13.9)	
Educational level (%)		
No formal education	28 (10.8)	
Primary school	91 (35.0)	
Secondary school	103 (39.6)	
Tertiary	38 (14.6)	

Characteristics	n (%)	Mean (95% CI)
Marital status (%)		
Single	20 (7.7)	
Married	197 (75.8)	
Divorced / widowed	43 (16.5)	
Working status (%)		
Employed	81 (31.2)	
Unemployed	179 (68.8)	
Presence of complication (%)		
Heart disease	35 (13.5)	
Nephropathy	75 (28.8)	
Stroke	32 (12.3)	
Body Mass Index, BMI (%)		
Normal (18.50 – 24.99 kg/m^2)	84 (32.3)	
Overweight (25.00 – 29.99 kg/m^2)	106 (40.8)	
Obese (≥ 30.00 kg/m^2)	70 (26.9)	
Blood pressure (%)		
Controlled (<140/90mmHg)	150 (57.7)	
Uncontrolled (≥140/90mmHg)	110 (42.3)	
Physical activity (%)		
Active	139 (53.5)	
Inactive	121 (46.5)	

3.2 Factors associated with presence of diabetes mellitus

Socio-demographic characteristics of the respondents, age, educational level and working status differed significantly comparing those with and without diabetes mellitus (Table 2). Interestingly, ethnicity had no significant association with diabetes condition. In contrast, age was significantly associated with diabetes condition. The occurrence of diabetes mellitus was more common with older respondents. A greater proportion of respondents without diabetes mellitus were secondary or tertiary graduates, employed worker and younger patients compared to those with diabetes mellitus. In addition, hypertensive patients with diabetes mellitus tended to have nephropathy when compared to those without diabetes.

Table 2: Hypertensive patient demographics and medical characteristics by presence of diabetes mellitus

Sociodemographic/ medical characteristics	With diabetes mellitus (n=156)	Without diabetes mellitus (n=104)	Test of significance
Age (mean ± SD)	59.74±11.73	51.69±13.74	t=4.897, p-value=0.0001
Ethnicity (%)			
Malay	57.1	56.7	
Chinese	28.8	29.8	X^2=0.039
Indian	14.1	13.5	p-value=0.981
Educational level (%)			
No formal education	13.5	6.7	
Primary school	41.0	26.0	
Secondary school	36.5	44.2	X^2=16.094
Tertiary	9.0	23.1	p-value=0.001
Marital status (%)			
Single	3.9	13.5	
Married	75.6	76.0	X^2=11.226
Divorced / widowed	20.5	10.5	p-value=0.004
Working status (%)			
Employed	21.8	45.2	X^2=15.927
Unemployed	78.2	54.8	p-value=0.0001
Presence of complication (%)			
Heart disease	16.7	8.7	X^2=3.439 p-value=0.064
Nephropathy	37.2	16.3	X^2=13.195 p-value=0.0001
Stroke	10.9	14.4	X^2=0.719 p-value=0.397

3.3 The effects of physical activity on HRQoL

Results of the MANCOVA analysis demonstrated a significant multivariate group effect of the presence hypertension (with and without diabetes mellitus) in SF-36 domains (Wilk's Lambda=0.89, F(6,258)=3.88, p=0.0001). The univariate ANCOVA (Table 3) revealed that the hypertension and diabetes patients had significantly lower quality of life scores in physical functioning, role physical, role emotional, general health, and bodily pain domains. A significant physical activity factor was found on SF-36 domains (Wilk's Lambda=0.89, F(6,258)=3.91, p=0.0001). Examination of the SF-36 domains separately, using the univariate test, showed that subjects that were more active scored significantly higher in all SF-36 domains, except vitality, when compared to less active individuals. An overall "physical activity x presence of diabetes" interaction effect was found to be significant, as shown by Wilk's Lambda=0.93, F(6,258)=2.35, and p=0.018. Interactions between physical activity and diabetes group were significant in physical functioning, role physical, role emotional, mental

health and social functioning domains. Table 3 shows comparisons for scores in different SF-36 domains, grouped according to physical activity and presence of diabetes. Patients with diabetes mellitus and less active were associated with the lowest SF-36 domains scores. The SF-36 scores of those without diabetes mellitus did not differ significantly, when comparing different physical activity levels.

Table 3: HRQoL according to physical activity level and presence of diabetes mellitus, mean±SD

Scores	With diabetes		Without diabetes		ANCOVA, *p*-value		
	Active (n=79)	Inactive (n=77)	Active (n=60)	Inactive (n=44)	Diabetes	Physical activity	Diabetes x physical activity
Physical function	81.33±21.79	57.34±32.75	88.75±15.48	82.05±16.96	0.0001	0.0001	0.011
Role-physical	74.31±28.10	40.83±35.41	81.84±21.78	77.27±25.61	0.0001	0.0001	0.0001
Bodily pain	76.55±25.80	65.55±29.97	82.04±23.98	81.08±24.25	0.004	0.040	0.107
General health	60.44±22.56	51.43±23.63	65.83±24.08	61.02±22.81	0.026	0.014	0.582
Role-emotional	86.80±20.49	64.72±37.19	85.37±19.77	85.42±24.58	0.024	0.002	0.004
Vitality	58.68±18.23	51.18±23.10	61.56±18.48	59.38±18.01	0.177	0.076	0.472
Mental health	75.95±15.70	64.64±24.28	74.51±17.20	75.23±16.56	0.068	0.009	0.024
Social function	90.44±18.62	66.07±32.37	88.36±18.62	81.25±24.78	0.109	0.0001	0.013

4.0 Discussion

Our results suggest that physical activity is important in patients' HRQoL assessment, and activity levels influence the outcome of hypertensive patients' answers to HRQoL questions. We observed better HRQoL among persons with higher levels of physical activity and this relationship extends across all ages and educational groups. In addition, the result of this study suggests that being physically active was associated with better scores in all aspects of HRQoL, except vitality.

Several studies have shown that high-intensity physical exercise can benefit HRQoL in both diseased and healthy populations (Brown et al., 2004; Pucci et al., 2012). In a prior cross-sectional research which examined the relationship between physical exercise and quality of life of hypertensive patients, positive correlations were found between physical exercise and HRQoL scores, especially in women and patients over 65 (Cuevas Fernandez et al., 2007). Brown *et al*. (2003) revealed strong relationships between physical activities and the number of physically unhealthy days, and with mentally unhealthy days, in the Behavioral Risk Factor Surveillance System (BRFSS) survey. A physically active lifestyle improves or maintains physical functioning, which may possibly contribute to higher HRQoL scores in physical

health domain (Weening-Dijksterhuis, de Greef, Scherder, Slaets, & van der Schans, 2011). Other studies have found that higher physical activity level was associated with less bodily pain and high ability to fulfill physical roles in midlife women (Dugan et al., 2009). A review concluded that patients with various health problems who had greater levels of exercise were associated with improved fitness and increased wellbeing (Penedo & Dahn, 2005). The present study supports this notion, as the group having higher physical activity levels had better scores in all the domains of HRQoL related to physical health (i.e. physical function, role limitations due to physical health, bodily pain, and general health) than those with less physically active counterparts. Results obtained in the present study indicate that there is a significant association between physical activity levels and the HRQOL mental components of SF-36 (i.e. mental health, role emotional, and social functioning). Acree and colleagues (2006) also observed a significant relationship between physical activity levels and mental health in elderly. Other studies have found that physical activity and exercise conferred psychological benefits, including reduced anxiety and depression, and improved mood (Penedo & Dahn, 2005; Strohle, 2009). Perhaps, physiological, neurobiological or psychological mechanisms are responsible for the impacts of physical activity on emotional functions.

The lack of a significant relationship between physical activity level and the domain of vitality found in the present investigation is supported by previous studies (Lindholm, Brevinge, Bergh, Körner, & Lundholm, 2003). In contrast, other reports found improvements in vitality following exercise interventions (Bize, Johnson, & Plotnikoff, 2007). It is possible that individuals with hypertension and diabetes commonly reported fatigue and tiredness (Fritschi & Quinn, 2010), hence, recorded narrowed range of vitality scores, thereby limiting the influence of physical activity has resulted in vitality domain. Moreover, the association between physical activity and vitality may be mediated through differences in body fat percentage (Stewart et al., 2003) and stage of exercise (Laforge et al., 1999). The mediation effects of these later variables, which may be confounders with interaction effects, were not examined, in the study reported here.

Health-related quality of life is a commonly used indicator among patients with hypertension and diabetes mellitus. This study supports the existing evidence that patients with hypertension and diabetes tend to rate lower quality of life scores. A notable finding of this study, in Malaysia, is the significant reduction in quality of life scores in physical functioning, role-physical, bodily pain, general health, and role-emotional domains in hypertensive patients with diabetes than in cases of hypertension *per se*. This is in line with previous studies, which noted that the presence of diabetes was an important factor limiting quality of life of hypertensive (Bardage & Isacson, 2001). However, Aydemir and colleagues (2005) showed that hypertension and diabetes had no further impact on quality of life. Different life settings may exert differential impacts here. Nevertheless, other studies have shown that diabetes and hypertension exerted additive effects on HRQoL (Wee, Cheung, Li, Fong, & Thumboo, 2005). Our results are important because they demonstrate that the impact of co-existing of diabetes and hypertension increases the physical and psychosocial burden of hypertension. In those studies (Wee et al., 2005), the mean duration between time of diagnosis of hypertension and study entry (years) was similar to our study. This may further indicate that both hypertension and diabetes overwhelmingly lead to lower quality of life.

Consistent with previous literature (Bardage & Isacson, 2001), it appears that the physical components are important in discriminating between quality of life of hypertensive patients

with and without diabetes. Thus, highly significant differences occur when comparing within domains of physical functioning, and physical role limitations. Studies on diabetes and quality of life have noted a similar trend (Schunk et al., 2012). Their data suggest that the impact of diabetes is more on physical components of SF-36 rather than mental components; thus similar to findings of this study. Another intriguing finding in our study is the association between presence of diabetes and role limitation due to mental health, which retained statistical significance after adjustment for covariates. Hence, there is similarity of our results to previous studies which reported that hypertension with diabetes led to poor mental health (Poljičanin et al., 2010; Wee et al., 2005). In contrast, other investigations have yielded conflicting results on the association between diabetes and mental health (Aydemir et al., 2005; Bardage & Isacson, 2001). Diabetes and hypertension is also often associated with other complications that require hospitalization and medications. Possibly, a change in mental health could be due to their awareness of having a disease and the association of complications with death was likely to produce reported adverse quality of life.

Some researchers suggested that the benefits of physical activity on HRQoL may depend on the presence and/or severity of chronic disease or chronic medical conditions (Brown et al., 2003; Penedo & Dahn, 2005). Similarly, we observed significant associations between regular physical activity and higher HRQoL among hypertensive patients without diabetes. Moreover, previous research has demonstrated the beneficial effects of regular physical activity on the prevention of type 2 diabetes mellitus (Laaksonen et al., 2005). Physical activity also reduces the symptoms of, and improves the functional status of persons, with diabetes and hypertension (Cornelissen, Fagard, Coeckelberghs, & Vanhees, 2011; Fagard, 2001). These benefits may produce higher HRQoL and better emotional wellbeing. For example, in a randomised trial of 140 participants with diabetes, with adults randomised to participate in resistance and aerobic trainings, significant improvements occurred across measures of blood pressure, fitness and body composition (Dobrosielski et al., 2012). Our data show that HRQoL scores reached higher values in more active hypertensive patients than in less active patients, and these scores were different comparing patients with and without diabetes.

The current study had a number of limitations. Firstly, the analysis was cross-sectional, making the determinations of cause and effect impossible to identify. Secondly, the physical activity level and HRQoL scores were obtained using only the self-reported questionnaire, therefore, an inaccurate estimation of both measures and recall bias are unavoidable. Finally, the current study used a relatively small convenience sample of hypertensive patients who had few comorbid conditions, thus generalisation of findings is limited. Nevertheless, the small window provided by this small study does highlight the importance of physical activity in influencing HRQoL of hypertensive.

5.0 Conclusion and recommendation

In summary, hypertensive patients who were physically active had higher scores in all domains of HRQoL than those who were physically inactive. These data give further strength to previous findings that higher levels of physical activity may improve HRQoL in both hypertensive patients with and without diabetes. Therefore, incorporating physical activity into the lifestyles of hypertensive patients is needed in order to improve their HRQoL and prevent complications.

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Declaration

The authors declare no conflict of interest.

Authors contribution

KWF: study conception and design, data collection and analysis, manuscript writing.
STSH: study conception and design, critical review of the manuscript.

References

Acree, L. S., Longfors, J., Fjeldstad, A. S., Fjeldstad, C., Schank, B., Nickel, K. J., . . . Gardner, A. W. (2006). Physical activity is related to quality of life in older adults. *Health Qual Life Outcomes, 4*(1), 37.

Aydemir, O., Ozdemir, C., & Koroglu, E. (2005). The impact of co-morbid conditions on the SF-36: a primary-care-based study among hypertensives. *Arch Med Res, 36*(2), 136-141. doi: 10.1016/j.arcmed.2004.12.009

Bardage, C., & Isacson, D. G. (2001). Hypertension and health-related quality of life. an epidemiological study in Sweden. *J Clin Epidemiol, 54*(2), 172-181.

Bize, R., Johnson, J. A., & Plotnikoff, R. C. (2007). Physical activity level and health-related quality of life in the general adult population: a systematic review. *Prev Med, 45*(6), 401-415. doi: 10.1016/j.ypmed.2007.07.017

Brown, D. W., Balluz, L. S., Heath, G. W., Moriarty, D. G., Ford, E. S., Giles, W. H., & Mokdad, A. H. (2003). Associations between recommended levels of physical activity and health-related quality of life. Findings from the 2001 Behavioral Risk Factor Surveillance System (BRFSS) survey. *Prev Med, 37*(5), 520-528.

Brown, D. W., Brown, D. R., Heath, G. W., Balluz, L., Giles, W. H., Ford, E. S., & Mokdad, A. H. (2004). Associations between physical activity dose and health-related quality of life. *Med Sci Sports Exerc, 36*(5), 890-896.

Chobanian, A. V., Bakris, G. L., Black, H. R., Cushman, W. C., Green, L. A., Izzo, J. L., Jr., . . . Roccella, E. J. (2003). The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. *JAMA, 289*(19), 2560-2572. doi: 10.1001/jama.289.19.2560

Cornelissen, V. A., Fagard, R. H., Coeckelberghs, E., & Vanhees, L. (2011). Impact of resistance training on blood pressure and other cardiovascular risk factors: a meta-analysis of randomized, controlled trials. *Hypertension, 58*(5), 950-958. doi: 10.1161/HYPERTENSIONAHA.111.177071

Craig, C. L., Marshall, A. L., Sjostrom, M., Bauman, A. E., Booth, M. L., Ainsworth, B. E., . . . Oja, P. (2003). International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc, 35*(8), 1381-1395. doi: 10.1249/01.MSS.0000078924.61453.FB

Cuevas Fernandez, F. J., Marco Garcia, M. T., Rodriguez Alvarez, C., Iglesias Giron, M. J., & Aguirre-Jaime, A. (2007). Is there an association between physical exercise and the quality of life of hypertensive patients? *Scand J Med Sci Sports, 17*(4), 348-355. doi: 10.1111/j.1600-0838.2006.00588.x

Dobrosielski, D. A., Gibbs, B. B., Ouyang, P., Bonekamp, S., Clark, J. M., Wang, N. Y., . . . Stewart, K. J. (2012). Effect of exercise on blood pressure in type 2 diabetes: a randomized controlled trial. *J Gen Intern Med, 27*(11), 1453-1459. doi: 10.1007/s11606-012-2103-8

Dugan, S. A., Everson-Rose, S. A., Karavolos, K., Sternfeld, B., Wesley, D., & Powell, L. H. (2009). The impact of physical activity level on SF-36 role-physical and bodily pain indices in midlife women. *J Phys Act Health, 6*(1), 33-42.

Fagard, R. H. (2001). Exercise characteristics and the blood pressure response to dynamic physical training. *Med Sci Sports Exerc, 33*(6 Suppl), S484-492; discussion S493-484.

Fritschi, C., & Quinn, L. (2010). Fatigue in patients with diabetes: a review. *J Psychosom Res, 69*(1), 33-41. doi: 10.1016/j.jpsychores.2010.01.021

Gress, T. W., Nieto, F. J., Shahar, E., Wofford, M. R., & Brancati, F. L. (2000). Hypertension and antihypertensive therapy as risk factors for type 2 diabetes mellitus. Atherosclerosis Risk in Communities Study. *N Engl J Med, 342*(13), 905-912.

Gu, H., Yang, J., Li, W., Teo, K., Liu, L., & Yusuf, S. (2013). PHYSICAL ACTIVITY AND ITS RELATIONSHIP WITH OBESITY HYPERTENSION AND DIABETES IN URBAN AND RURAL CHINA: THE PURE CHINA STUDY. *Journal Of The American College Of Cardiology, 61*(10_S).

Khaw, W. F., Syed Hassan, S. T., & Abd Latiff, L. (2011). Health-related quality of life among hypertensive patients compared with general population norms. *Journal of Medical Sciences, 11*(2), 84-89.

Laaksonen, D. E., Lindstrom, J., Lakka, T. A., Eriksson, J. G., Niskanen, L., Wikstrom, K., . . . Finnish diabetes prevention, s. (2005). Physical activity in the prevention of type 2 diabetes: the Finnish diabetes prevention study. *Diabetes, 54*(1), 158-165.

Laforge, R. G., Rossi, J. S., Prochaska, J. O., Velicer, W. F., Levesque, D. A., & McHorney, C. A. (1999). Stage of regular exercise and health-related quality of life. *Prev Med, 28*(4), 349-360. doi: 10.1006/pmed.1998.0429

Lawrence, W. F., Fryback, D. G., Martin, P. A., Klein, R., & Klein, B. E. (1996). Health status and hypertension: a population-based study. *J Clin Epidemiol, 49*(11), 1239-1245. doi: S0895-4356(96)00220-X [pii]

Lindholm, E., Brevinge, H., Bergh, C.-H., Körner, U., & Lundholm, K. (2003). Relationships between self-reported health related quality of life and measures of standardized exercise capacity and metabolic efficiency in a middle-aged and aged healthy population. *Quality of Life Research, 12*(5), 575-582.

Liu, J., Zhao, D., Liu, J., Qi, Y., Sun, J., & Wang, W. (2013). Prevalence of diabetes mellitus in outpatients with essential hypertension in China: a cross-sectional study. *BMJ open, 3*(11), e003798.

Mena-Martin, F. J., Martin-Escudero, J. C., Simal-Blanco, F., Carretero-Ares, J. L., Arzua-Mouronte, D., & Herreros-Fernandez, V. (2003). Health-related quality of life of subjects with known and unknown hypertension: results from the population-based Hortega study. *J Hypertens, 21*(7), 1283-1289. doi: 10.1097/01.hjh.0000059086.43904.17

Ministry of Health Malaysia. (2008). The Third National Health and Morbidity Survey (NHMS III)

Mishra, S. I., Scherer, R. W., Geigle, P. M., Berlanstein, D. R., Topaloglu, O., Gotay, C. C., & Snyder, C. (2012). Exercise interventions on health-related quality of life for cancer survivors. *The Cochrane Library*.

Padilla, J., Wallace, J. P., & Park, S. (2005). Accumulation of physical activity reduces blood pressure in pre- and hypertension. *Med Sci Sports Exerc, 37*(8), 1264-1275. doi: 00005768-200508000-00003 [pii]

Penedo, F. J., & Dahn, J. R. (2005). Exercise and well-being: a review of mental and physical health benefits associated with physical activity. *Curr Opin Psychiatry, 18*(2), 189-193.

Poljičanin, T., Ajduković, D., Šekerija, M., Pibernik-Okanović, M., Metelko, Ž., & Mavrinac, G. V. (2010). Diabetes mellitus and hypertension have comparable adverse effects on health-related quality of life. *BMC public health, 10*(1), 12.

Pucci, G., Reis, R. S., Rech, C. R., & Hallal, P. C. (2012). Quality of life and physical activity among adults: population-based study in Brazilian adults. *Qual Life Res, 21*(9), 1537-1543. doi: 10.1007/s11136-011-0083-5

Rampal, L., Rampal, S., Azhar, M. Z., & Rahman, A. R. (2008). Prevalence, awareness, treatment and control of hypertension in Malaysia: a national study of 16,440 subjects. *Public Health, 122*(1), 11-18. doi: 10.1016/j.puhe.2007.05.008

Sararaks, S., Azman, A. B., Low, L. L., Rugayah, B., Aziah, A. M., Hooi, L. N., . . . Geeta, S. (2005). Validity and reliability of the SF-36: the Malaysian context. *Med J Malaysia, 60*(2), 163-179.

Schunk, M., Reitmeir, P., Schipf, S., Völzke, H., Meisinger, C., Thorand, B., . . . Holle, R. (2012). Health-related quality of life in subjects with and without Type 2 diabetes: pooled analysis of five population-based surveys in Germany. *Diabetic Medicine, 29*(5), 646-653. doi: 10.1111/j.1464-5491.2011.03465.x

Shibata, A., Oka, K., Nakamura, Y., & Muraoka, I. (2007). Recommended level of physical activity and health-related quality of life among Japanese adults. *Health Qual Life Outcomes, 5*, 64. doi: 10.1186/1477-7525-5-64

Stewart, K. J., Turner, K. L., Bacher, A. C., DeRegis, J. R., Sung, J., Tayback, M., & Ouyang, P. (2003). Are fitness, activity, and fatness associated with health-related quality of life and mood in older persons? *J Cardiopulm Rehabil, 23*(2), 115-121.

Strohle, A. (2009). Physical activity, exercise, depression and anxiety disorders. *J Neural Transm, 116*(6), 777-784. doi: 10.1007/s00702-008-0092-x

Taylor, R. S., Brown, A., Ebrahim, S., Jolliffe, J., Noorani, H., Rees, K., . . . Oldridge, N. (2004). Exercise-based rehabilitation for patients with coronary heart disease: systematic review and meta-analysis of randomized controlled trials. *Am J Med, 116*(10), 682-692.

Testa, M. A., & Simonson, D. C. (1996). Assessment of Quality-of-Life Outcomes. *N Engl J Med, 334*(13), 835-840.

Wang, R., Zhao, Y., He, X., Ma, X., Yan, X., Sun, Y., . . . He, J. (2009). Impact of hypertension on health-related quality of life in a population-based study in Shanghai, China. *Public Health, 123*(8), 534-539. doi: 10.1016/j.puhe.2009.06.009

Wee, H. L., Cheung, Y. B., Li, S. C., Fong, K. Y., & Thumboo, J. (2005). The impact of diabetes mellitus and other chronic medical conditions on health-related Quality of Life: is the whole greater than the sum of its parts? *Health Qual Life Outcomes, 3*, 2. doi: 10.1186/1477-7525-3-2

Weening-Dijksterhuis, E., de Greef, M. H., Scherder, E. J., Slaets, J. P., & van der Schans, C. P. (2011). Frail institutionalized older persons: A comprehensive review on physical exercise, physical fitness, activities of daily living, and quality-of-life. *Am J Phys Med Rehabil, 90*(2), 156-168. doi: 10.1097/PHM.0b013e3181f703ef