UNIVERSITI PUTRA MALAYSIA

EFFECTS OF A 16-WEEK, HOME-BASED, HIGH-INTENSITY, PROGRESSIVE-RESISTANCE TRAINING PROGRAM ON GLUCOSE HOMEOSTASIS, CARDIOVASCULAR DISEASE RISK FACTORS AND FUNCTIONAL CAPACITY OF OLDER MALAYSIANS WITH TYPE 2 DIABETES MELLITUS

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By

ARIMI FITRI MAT LUDIN

Thesis Submitted to the School of Graduates Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Doctor of Philosophy

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Doctor of Philosophy

EFFECTS OF A 16-WEEK, HOME-BASED, HIGH-INTENSITY, PROGRESSIVE-RESISTANCE TRAINING PROGRAM ON GLUCOSE HOMEOSTASIS, CARDIOVASCULAR DISEASE RISK FACTORS AND FUNCTIONAL CAPACITY OF OLDER MALAYSIANS WITH TYPE 2 DIABETES MELLITUS

By

ARIMI FITRI MAT LUDIN

JUNE 2013

Chair : Loke Seng Cheong, MBBS, MRCP, FAMS

Faculty : Institut of Gerontology

Ageing is an inevitable process and it is associated with multiple chronic diseases, one of which is Type 2 Diabetes Mellitus (T2DM). An increasing ageing population in Malaysia means that medical problems which affect the elderly are on the rise. Research has proven that aerobic exercise improves glucose homeostasis. However, the dose and setting in which tests were applied in current research are not viable for implementation on the elderly especially within the general population. Home-based Progressive Resistance Training (PRT) could be an alternative solution, as it promotes favourable improvement on the conditions of the elderly with T2DM. The hypothesis of this study which was a 16-week home-based PRT is associated with a significant improvement on T2DM management among the elderly. In this regard, the aim of this study was to measure the effects of a 16-week home-base high intensity PRT on glucose homeostasis, risk factors and functional capacity among elderly subjects with T2DM. The study also intends to assess the occurrence of adverse events following the exercise protocol. The sample size calculation was

done using G-power with Type I and Type II errors set at 5%, effect size *f* at 0.25. To achieve the predetermined study power, a total of 70 patients, aged 61.7 ± 5.5 years (intervention, *n* = 35 vs. control, *n* = 35) attending the Serdang Hospital participated in this quasi-experimental trial. The whole body exercise training regime consisted of 2 main parts: a one-to-one training session for the first two weeks for familiarization and a home-based exercise program for the remaining 14 weeks with monthly follow-ups. Glucose homeostasis (HbA1c and fasting blood glucose level, FBG), body composition (body mass, BMI, fat and muscle mass), cardiovascular risk factors (blood lipid profile, systolic (SBP) and diastolic blood pressures (DBP), resting heart rate, and ankle-brachial index and functional capacity (Sit-to-Stand Test, Stair Climb Test, 6-Minute Walking Test (6MWT), static balance and muscle strength) were measured before and after intervention. With the exception of systolic blood pressure ($p < .05$), the results revealed no significant difference between intervention and control groups in all variables observed at the baseline prior to commencement of training. The post-intervention measurements showed significant reduction in HbA1c (14.3%, $p < .001$), FBG (14.1%, $p < .001$), body mass (0.8%, $p < .05$), body fat mass (0.9%, $p < .05$) and systolic blood pressure (1.1%, $p < .05$). There were significant improvements in functional capacity, i.e. Sit-to-Stand (15.2%, $p < .001$), Stair Climb (11.4%, $p < .001$) and 6MWT (9.1%, $p < .001$). Muscle strength also improved significantly, i.e. hand grip strength (7.2%, $p < .01$), upper body strength (34.0%, $p < .05$) and lower body strength (48.3%, $p < .05$). No significant improvements were observed in diastolic blood pressure, heart rate, BMI, lipid profile, static balance and ankle brachial index. There were no significant complications or adverse events reported. This study suggests the exercise regime

implemented is effective and caused no adverse events in improving glycemic control, and the functional capacity among the Malaysian elderly with T2DM.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Doktor Falsafah

KESAN 16-MINGGU, SENAMAN RINTANGAN PROGRESIF, INTENSITI TINGGI BERPUSAT-KEDIAMAN KE ATAS HOMEOSTASIS GLUKOSA, FAKTOR RISIKO PENYAKIT KARDIOVASKULAR DAN KAPASITI FUNGSIAN WARGA TUA MALAYSIA PENGIDAP DIABETES MELITUS JENIS 2

Oleh

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Penuaan adalah proses yang tidak dapat dielakkan dan ianya berkaitan rapat dengan pelbagai penyakit kronik, termasuklah diabetis melitus jenis 2 (T2DM). Dengan peningkatan warga tua di Malaysia, masalah perubatan berkaitan dengannya juga turut meningkat. Penyelidikan telah membuktikan senaman aerobik mampu memperbaiki homeostasis glukosa. Walaubagaimanapun, dos dan tetapan yang diguna pakai dalam kajian sukar untuk diaplikasikan pada warga tua terutamanya di peringkat populasi. Senaman rintangan progresif berpusatkan kediaman boleh menjadi alternatif bagi memberikan kesan setara kepada warga tua pengidap T2DM. Hipotesis kajian ini adalah, senaman rintangan progresif selama 16 minggu memberikan kesan sigfinifkan dalam pengurusan T2DM dalam kalangan warga tua. Maka, matlamat kajian ini adalah bagi mengukur kesan senaman rintangan progresif tinggi berpusatkan kediaman ke atas homeostasis glukosa, faktor risiko kardiovaskular dan kapasiti fungsian dalam kalangan warga tua pengidap T2DM. Kajian juga bertujuan untuk menilai kesan yang tidak diingini selepas menjalani protokol senaman ini. Pengiraan saiz sampel menggunakan G-

power dengan Ralat Jenis I dan II adalah 5%, kesan saiz *f* 0.25 dan bagi mencapai mencapai pratetapan kekuatan kajian pada 95%, seramai 70 pesakit (intervensi, *n* = 35 vs. kawalan, *n* = 35) berumur 61.7 ± 5.5 tahun yang mendapatkan rawatan di Hospital Serdang meyertai kajian kuasi-eksperimental ini. Intervensi senaman bermula dengan sesi individu selama 2 minggu bagi membiasakan diri. Subjek meneruskan baki 14 minggu di kediaman masing-masing dengan sesi ulangan bulanan. Homeostasis glukosa (aras HbA1c dan glukosa darah puasa, GDP), komposisi tubuh (berat tubuh, indeks jisim tubuh, berat dan peratusan lemak tubuh dan juga jisim otot), faktor risiko kardiovaskular (profil lipid, tekanan darah sistolik (SBP) dan diastolik (DBP), kadar nadi rehat dan *ankle-brachial index*) dan kapisiti fungsian (ujian *Sit-to-Stand, Stair Climb*, *6-Minute Walking Test*, keseimbangan statik dan kekuatan otot anggota atas dan bawah badan) diukur sebelum dan selepas intervensi. Tiada perbezaan signifikan bagi kesemua parameter di permulaan kajian kecuali SBP ($p < .05$). Penilaian selepas intervensi menunjukkan penurunan yang signifikan bagi aras HbA1c (14.3%, $p < .001$) dan GDP (14.1%, $p < .001$), berat tubuh (0.8%, $p < .05$), jisim lemak (0.9%, $p < .05$) dan tekanan darah sistolik (1.1%, $p < .05$). Didapati juga peningkatan yang signifikan bagi kapasiti fungsian; *Sit-to-Stand* (15.2%, $p < .001$), *Stair Climb* (11.4%, $p < .001$) dan *6-Minute Walking Test* (9.1%, $p < .001$). Kekuatan otot menunjukkan peningkatan yang signifikan dengan kekuatan genggaman (7.2%, $p < .01$), kekuatan anggota atas (34.0%, $p < .05$) dan bawah (48.3%, $p < .05$)badan. Tiada perbezaan signifikan ditunjukkan bagi DBP, kadar nadi rehat, indeks jisim tubuh, profil lipid, keseimbangan statik dan *ankle-brachial index.* Tiada kompilkasi dan kesan sampingan yang memerlukan perhatian perubatan dilaporkan. Kajian ini

mencadangkan intervensi senaman yang dilakukan adalah efektif dan tidak menyebabkan berlakunya kesan sampingan dalam memperbaiki homeostasis gula darah dan meningkatkan kapasiti fungsian warga tua Malaysia pengidap T2DM.

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May blessing from Allah will always be with us.

I certify that an Examination Committee has met on 3rd June 2013 to conduct the final examination of Arimi Fitri Mat Ludin on his Doctor of Philosophy thesis entitled "Effects Of A 16-Week, Home-Based, High-Intensity, Progressive-Resistance Training Program On Glucose Homeostasis, Cardiovascular Disease Risk Factors And Functional Capacity Of Older Malaysian With Type 2 Diabetes Mellitus" in accordance with the Universities and University-College Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy.

Members of the Examination Committee were as follow:

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for degree of Doctor of Philosophy. The members of the Supervisory Committee were as follow:

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DECLARATION

I declare that the thesis is my original work except for quotations and citation which have been duly acknowledged. I also declare that it has not been previously, and is not currently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

ARIMI FITRI MAT LUDIN

Date: 3 JUNE 2013

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