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Title of the PhD Theses: Exercise Interventions in the Management of Type 2 Diabetes Mellitus in Indian Population

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Aims and objectives of the studies: The purpose of the present doctoral theses are to test the measurement properties of muscular strength estimation in untrained middle aged type 2 diabetic patients and to investigate the efficacy of progressive resistance exercise program on metabolic, musculoskeletal and cardiovascular parameters. The specific objectives were:

1. To assess the test retest reliability of 1-RM estimation for upper and lower body muscular strength measurements in untrained middle aged type 2 diabetic patients.
2. To investigate whether resistance exercise is an efficacious treatment for glycemic control and muscle strength in Asian Indians with Type 2 Diabetes.
3. To assess the influence of resistance type exercise training on cardiovascular risk factors such as dyslipidemia and blood pressure.
4. To study the dose-response relation of resistance exercise and reduction in blood glucose level and muscle strength.

Methodology, results and discussion of the studies

Study 1: Agreement analysis study: This study examined the reliability of the estimated 1-RM strength test of untrained middle aged individuals with T2D. Twenty five untrained diabetic males (n=19) and females (n=6) aged 40.7±0.4 years participated in the study. Participants undertook the first estimated 1-RM test for five exercises. A familiarisation session was provided three to five days before the first test. 1-RM was estimated for all participants by Brzycki 1-RM prediction equation. Three to five days after first test, participants underwent another identical I-RM estimation procedure. Intraclass correlation coefficients (ICC), paired *t*-test, standard error of measurement (SEM), Bland-Altman plots, and estimation of 95% confidence limits were used to assess reliability.

Test-retest reliability was excellent ($ICC_{2,1}$=0.98-0.99) for all measurements. The findings of this study suggests that estimated 1-RM testing method is reliable for upper and lower body muscular strength measurement in untrained middle aged T2D patients.

Study 2: Efficacy and dose response study: The purpose of the current study was to determine the efficacy of progressive resistance training on glycemic, musculoskeletal, metabolic, anthropometric and cardiovascular variables in untrained middle aged T2D patients living in North India. A total of 48 untrained middle aged Asian Indian patients with T2D were randomised to receive a PRT, or placebo (flexibility exercises). Primary outcomes were 1) glycemic control measured as HbA1c and FPG and 2) muscle strength measured as 1-repetition maximum bench press and 1-repetition maximum leg press. Secondary outcomes included 1) body composition measured with body weight and waist circumference 2) cardiovascular risk factors measured as total cholesterol, triglycerides, high density lipoprotein cholesterol, low density lipoprotein cholesterol, systolic blood pressure and diastolic blood pressure. All outcomes were measured at baseline and after 8 weeks of training.

Mixed model analysis of variance revealed a significant group-by-time interaction for the main outcomes of the study: Glycemic control (P< .001) and muscle strength (P< .001), waist circumference (P = .008), and HDL- cholesterol (P = .004). However no significant group-by-time interaction was detected on body weight, total cholesterol, triglycerides, LDL-Cholesterol, systolic and diastolic blood pressure. This is the first controlled study ever to demonstrate that PRT exercise is better than placebo for Asian Indian patients with T2D.

These results suggest that this intervention should be considered for patients with T2D in order to improve glycemic control, muscular strength, HDL-cholesterol etc and to reduce waist circumference.

Conclusions: Overall, the studies included in this thesis have provided an important contribution to the contemporary management of T2D. Firstly the use of resistance exercise could be considered for Asian Indian patients with T2D as it produces improvements in glycemic control, muscular strength, waist circumference and HDL-Cholesterol. Secondly, both 3 days a week and 2 days a week PRT were found to be equally effective for glycemic control, where as 3 days per week training is more appropriate for improvements in muscle strength with concomitant decrease in mean blood sugar levels. Thirdly 1RM estimation in patients with T2D was considered reproducible for the measurement of muscle strength.