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Original Research

Changes in exercise capacity and anthropometric measures after *Work It Out*—a holistic chronic disease self-management program for urban Aboriginal and Torres Strait Islander people

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ARTICLE INFO

Article history:
Received 19 November 2018
Received in revised form
22 April 2019
Accepted 30 May 2019
Available online 15 July 2019

Keywords:
Indigenous health
Six-minute walk distance
Program evaluation

ABSTRACT

Objectives: The *Work It Out* (WIO) program is a holistic chronic disease self-management and rehabilitation program in Queensland that is tailored for urban Aboriginal and Torres Strait Islander people with/at risk of chronic disease. This study aimed to examine the overall changes in participants' exercise capacity and anthropometric measurements and to explore the correlations between these changes.

Study design: Quasi-experimental prepost intervention study.

Methods: A total of 406 participants self-identified as Aboriginal and Torres Strait Islander people, who had attended one or more cycles of the program from 2014 to 2017, were included. Health information from the last review assessment was compared with that of the initial assessment using paired *t*-tests. Multivariate regression models were applied to explore the associations between changes in 6-min walk distance (6MWD) and anthropometric measurements.

Results: An increase in 6MWD (77 m, 95% confidence interval [CI]: 65, 90), as well as small reductions in waist circumference (WC) (−1.79 cm, 95% CI: −2.76 to −0.82) and hip circumference (−1.11 cm, 95% CI: −2.13 to −0.08) were identified. Statistically significant reductions were observed across all anthropometric measures in the respective highest tertiles (body mass index: −0.71, 95% CI: −1.35 to −0.07; weight: −2.59 kg, 95% CI: −4.84 to −0.34; WC: −5.09 cm, 95% CI: −6.99 to −3.20; waist to hip ratio: −0.033, 95% CI: −0.047 to −0.02). The increments of 6MWD in returning participants (92 m, 95% CI: 75 to 109) was found to be greater than those in one-off participants (59 m, 95% CI: 40–78). In particular, the percentage of 6MWD change from baseline was significantly correlated to the percentage of WC change after adjusting for age, gender, the number of pre-existing chronic conditions, and the number of cycles attended (coefficient: −1.33, 95% CI: −2.42 to −0.24).

Conclusion: Significant improvement in functional exercise capacity and modest changes in anthropometric measurements were identified in WIO participants. WC change could be used as an indicator of the change of participants' six-minute walk distance. Findings may

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https://doi.org/10.1016/j.puhe.2019.05.035

be useful for promoting and guiding similar health programs for improving chronic disease management in Australian Indigenous communities.

Introduction

Chronic disease is a leading cause of disability and death globally.[1] The increasing burden of chronic disease represents a significant challenge to Australia's health system.[2] While prevention strategies have mainly targeted reducing a range of common risk factors, improved management of chronic diseases including through self-management has also been an important focus.[1] Research has found that chronic disease self-management programs can be effective in improving patients' health behaviors, health outcomes, quality of life and reducing healthcare expenditure.[3] However, such studies are rare among Aboriginal and Torres Strait Islander people in Australia, particularly those living in urban settings.[4]

Physical inactivity substantially contributes to the development of a number of chronic diseases and shorter life expectancy.[5] The level of physical fitness plays an important role in reducing mortality risks, because less fit individuals, while experiencing higher rates of obesity, are shown to have a higher mortality risk irrespective of their body mass index (BMI) values.[6] In addition, obesity contributes to the health gap between Indigenous Australians and other populations in Australia.[7] Health surveys conducted during 2012–2013 found that Indigenous Australians are 1.6 times more likely to be obese than their non-Indigenous counterparts after adjusting for the differences in age structure among the two populations.[8] Physical inactivity and obesity are risk factors for many chronic diseases that are prevalent in the Aboriginal and Torres Strait Islander population in Australia, especially among those living in urban areas.[9]

Work It Out (WIO) is a holistic chronic disease self-management and rehabilitation program, which is specifically designed for Aboriginal and Torres Strait Islander people residing in urban and regional cities of southeast and central Queensland. The program aims to improve participants' physical functioning, general well-being, and chronic disease self-management knowledge and behavior.[10,11] Participants with chronic conditions or at risk of chronic disease are referred to the program, where they can participate in two WIO sessions every week. Each session consists of a 45-min education component and 1-h exercise physiologist supervised group exercise component. A group of allied health professionals, which includes occupational therapists, exercise physiologists, psychologists, dietitians, pharmacists, podiatrists, optometrists, diabetes educators, and other health promotion practitioners, are responsible for the delivery of the educational components. Knowledge of chronic disease and self-management, heathy eating, importance of physical activity, stress management and relaxation, and many other health-related topics are included in the education sessions.

Previous analysis of qualitative interview data shows that the WIO program is effective in eliciting physical changes and lifestyle improvements, as well as increasing social and emotional well-being.[10] Weight reduction and decreased systolic blood pressure in specific groups was found after one cycle of the program (12 weeks) among 85 participants with or at risk of cardiovascular diseases.[11] However, quantitative analysis from a larger number of participants with a range of chronic conditions and with a longer follow-up period are deemed to be necessary to reflect the overall effects of this program on participants' physiological health as well as functional exercise capacity.

There are several clinical measures that can indicate a client's physical fitness levels. The 6-min walk test has been widely used in various studies as an indicator for exercise capacity[12] and to predict morbidity and mortality in various clinical settings.[12,13] It has also been utilized to monitor patients' physical fitness in clinical and intervention studies in Aboriginal and Torres Strait Islander people.[14]

Anthropometric measurements, which indicate human body size, body fat distribution, and body composition, are effective predictors of cardiovascular diseases as well as type 2 diabetes in Aboriginal people.[15,16] In clinical settings and epidemiological studies, obesity-related measurements, such as BMI, waist circumference (WC), and waist to hip ratio (WHR), are commonly used to predict risk of diseases and mortality.[17] As complementary measurements for obesity, WC reflects abdominal fat storage, and WHR indicates body fat distribution.[17] Dalton et al. noted that WHR was the most useful indicator of cardiovascular disease (CVD) risk factors among Australian adults.[18] However, other researchers argued that WC was better than WHR as an indicator for CVD and type 2 diabetes in remote Indigenous communities of Australia.[15,16]

This study aimed to examine the overall effects of the WIO program on exercise capacity and anthropometric measurements. It also explored the correlations between participants' exercise capacity change and changes of anthropometric measurements.

Methods

This study employed a quasi-experimental prepost intervention study design. Details of the WIO program have been published elsewhere.[10,11] Aboriginal and Torres Strait Islander people with one or more chronic diseases or who have a risk factor of chronic disease are eligible for the program without any out-of-pocket cost. Participants were referred to the WIO program at a participating Aboriginal and Torres Strait Islander Community Controlled Health Service after a health check or a GP management plan for chronic disease management. They were then initially assessed at baseline across a number of health indicators by an exercise physiologist. The WIO program was initiated and conducted by the Institute for

Urban Indigenous Health with a high proportion of staff being identified as Aboriginal and/or Torres Strait islander people. To ensure the program is culturally appropriate, an Aboriginal Health Worker or other Aboriginal and Torres Strait Islander staff member is usually present and working closely with the exercise physiologist at each WIO session. The WIO program runs four cycles in a year, with around 12 weeks in each cycle; therefore, those who stayed in the program were subsequently assessed using the same indicators at the end of each cycle. To evaluate the possible effects of the WIO program, the information from the last assessment of each participant was used to compare with their baseline information.

From January 2014 to December 2017, a total of 1007 patients who self-identified as Aboriginal and Torres Strait Islander people were referred to the program and 406 participants who had completed an initial assessment and one or more subsequent 12 weekly review assessments were included for analysis in this study. At baseline, participants were significantly older than those who did not participate in the program, and other measurements including 6-min walk distance (6MWD), weight, BMI, WC, and WHR, were not significantly different.

General demographic information such as age, gender, and pre-existing health conditions was collected at initial assessment. Diagnosed chronic conditions such as cardiovascular disease, diabetes mellitus, respiratory disease, mental illness, musculoskeletal conditions, cancers, hepatitis, metabolic conditions, cholesterol disorders, obesity, hypertension, and other conditions were recorded. At initial and each subsequent review assessment, anthropometric measurements including weight, height, WC, and hip circumference (HC) were measured using standardized methods and tools.[11] BMI was calculated using baseline weight divided by height squared (kg/m^2). Functional exercise capacity was measured using the 6-min walk test, where participants were instructed to walk their maximum distance in a total of 6 min.[14]

Descriptive analysis was performed on all 406 WIO participants. Mean (standard deviation [SD]) and median (95% confidence interval [CI]) for continuous variables or number (percentage) for categorical variables of demographic characteristics and baseline measurements were reported. Outcome variables included the changes between baseline and the last review assessment for 6MWD, weight, WC, HC, BMI, and WHR. Changes were calculated using values of the last review measurements minus values of baseline measurements; hence, positive values represent increases while negative values represent reductions. Paired *t*-tests were used to test the mean changes between baseline measurements and the last review measurements. Analyses were then conducted separately for one-off or returning participants, as well as in subgroups categorized by the tertiles of baseline weight, BMI, WC, HC, and WHR values, respectively. One-way analysis of variance was applied to test the difference of changes achieved between one-off and returning participants.

Furthermore, bivariate and multivariate linear regression models were applied to explore the correlations between changes in 6MWD and anthropometric measurements. The dependent variable was the percentage change from baseline for 6MWD. The independent variable was the percentage change from baseline for BMI, WC, or WHR, respectively. The following variables were adjusted for in all multivariate models: age at initial assessment, gender, the number of pre-existing chronic conditions, and the number of cycles attended. All data analyses were performed by Stata version 14 for Windows.[19] The significance level was set at two-sided *P*-value as 0.05.

Results

The mean age of the participants was 52.9 (SD, 14.2) years, ranged from 17 to 82 years. Females comprised 62.6% of the participants. Participants attended the program for at least one cycle to up to 11 cycles. However, participants may not have attended all sessions in each cycle because of family and community commitments or health issues. Participants had a number of chronic conditions (median 6; interquartile range 4–8) prior entry to the program. The majority (85.5%) of the participants were overweight and obese (BMI $\geq$ 25 kg/m^2) at baseline. Detailed information about participants' demographic characteristics are summarized in Table 1.

Tables 2 and 3 show the results of paired *t*-tests, which profile the changes of 6MWD, BMI, body weight, WC, HC, and WHR between initial assessment and last review assessment. There was an increase in 6MWD (mean: 77 m), as well as small reductions in WC (mean: 1.79 cm) and HC (mean: 1.11 cm).

Further analyses indicate that the reductions were most evident among participants in the highest tertiles of their baseline values for all anthropometric measures (Table 3). However, 6MWD unanimously increased in all three groups

Table 1 – Demographic characteristics of 406 participants, mean (SD) otherwise as stated.

Demographic characteristics	Value
Male, *n* (%)	152 (37.4)
Female, *n* (%)	254 (62.6)
Age, years, mean (SD)	52.9 (14.2)
Age group in years, *n* (%)	
16-29	29 (7.1)
30-44	74 (18.2)
45-59	166 (40.9)
≥60	137 (33.8)
Number of cycles attended, *n* (%)	
1	180 (44.3)
2	58 (14.3)
3-4	88 (21.7)
≥5	80 (19.7)
Number of chronic conditions[a], median (IQR)	6 (4–8)
BMI categories[b], *n* (%)	
Normal weight	31 (7.6)
Over weight	73 (18.0)
Obese	274 (67.5)
Missing	28 (6.9)

IQR, interquartile range; BMI, body mass index; SD, standard deviation.

[a] Pre-existing chronic conditions include cardiovascular diseases, diabetes mellitus, respiratory diseases, mental illness, musculoskeletal conditions, cancers, hepatitis, metabolic conditions, cholesterol disorders, obesity, hypertension, and other conditions.

[b] Normal weight: 18.5 ≤ BMI < 25 kg/m^2; over weight: 25 ≤ BMI < 30 kg/m^2; obese: BMI ≥30 kg/m^2.

Table 2 – Changes on 6MWD and anthropometric measurements.

Health measurements	N	Baseline values [mean (SD)]	Mean change[a] (95% CI)	P-value
6MWD, meters	313	395 (120)	77 (65–90)	<0.001
BMI, kg/m^2	347	35.26 (8.22)	−0.04 (−0.39 to 0.31)	0.84
Weight, kg	351	97.95 (24.97)	−0.50 (−1.43 to 0.43)	0.35
WC, cm	347	113.43 (17.52)	−1.79 (−2.76 to −0.82)	<0.001
HC, cm	338	118.83 (16.98)	−1.11 (−2.13 to −0.08)	0.034
WHR	335	0.96 (0.10)	−0.007 (−0.015 to <0.001)	0.043

CI, confidence interval; BMI, body mass index; WC, waist circumference; WHR, waist to hip ratio; 6MWD, 6-min walk distance; HC, hip circumference.
[a] Positive values represent increases, negative values represent reductions.

Table 3 – Changes in subgroups categorized by tertiles of baseline values.

Variables	Tertiles of baseline	N	Mean change[a] (95% CI)	P
6MWD, meters				
	29–351	105	140 (115–166)	<0.001
	352–450	107	71 (57–85)	<0.001
	451–870	101	19 (<1 to 39)	0.049
BMI, kg/m^2				
	19.00–31.45	116	0.59 (0.06–1.11)	0.030
	31.46–38.00	116	0.01 (−0.64 to 0.66)	0.98
	38.01–69.20	115	−0.71 (−1.35 to −0.07)	0.029
Weight, kg				
	48.50–85.73	117	0.89 (−0.01 to 1.78)	0.052
	85.74–105.34	117	0.20 (−1.18 to 1.59)	0.77
	105.34–200.00	117	−2.59 (−4.84 to −0.34)	0.025
WC, cm				
	71.00–105.33	119	−0.25 (−1.57 to 1.06)	0.70
	105.34–121.42	120	−0.34 (−2.04 to 1.36)	0.69
	121.43–166.00	108	−5.09 (−6.99 to −3.20)	<0.001
HC, cm				
	77.00–110.10	116	0.57 (−0.35 to 1.48)	0.22
	110.11–124.34	114	−0.79 (−2.29 to 0.72)	0.30
	124.35–188.50	108	−3.24 (−5.84 to −0.65)	0.015
WHR				
	0.70–0.91	112	0.016 (0.007–0.026)	0.0012
	0.92–1.00	113	−0.006 (−0.018 to 0.007)	0.38
	1.00–1.25	110	−0.033 (−0.047 to −0.020)	<0.001

CI, confidence interval; BMI, body mass index; WC, waist circumference; WHR, waist to hip ratio; 6MWD, 6-min walk distance; HC, hip circumference.
[a] Positive values represent increases, negative values represent reductions.

with the largest increase in the lowest tertile of 6MWD (Table 3).

Table 4 shows the changes over one-off and returning participation in the program. For 6MWD, there was an average increase of 92 m in participants who attended two or more cycles of the program vs 59 m increase in those who attended only one cycle ($P = 0.01$). There was no significant difference in changes achieved for all anthropometric measures among the one-off and returning WIO program participants.

More than three-quarters (78.3%) of participants increased their 6MWD after participation in the program. BMI decreased or remained unchanged in 45.5% of WIO participants, while more than half of participants reduced or had no change in WC (60.2%), HC (55.9%), and WHR (51.6%). In multivariate linear regression models, age, gender, number of pre-existing chronic conditions, and the number of cycles attended were adjusted for. The adjusted coefficient and 95% CI were −0.14 (−1.07 to 0.79) for BMI, −1.33 (−2.42 to −0.24) for WC, and −0.63 (−1.86 to 0.61) for WHR, respectively (Table 5).

Discussion

This article provides a comprehensive profile of changes of 6MWD and anthropometric measurements among the Aboriginal and Torres Strait Islander people who attended the WIO program. Results demonstrated significant improvement of exercise capacity and modest change in anthropometric measurements in WIO participants. The improvement of exercise capacity was significantly related to WC change rather than BMI or WHR changes.

Evaluations of intervention programs targeting Aboriginal and Torres Strait Islander people of Australia are limited; usually with small sample sizes, short follow-up time, and

Table 4 – Changes on 6MWD and anthropometric measurements in one-off and returning participants.

Health measurements	Participation (no. of cycles)	N	Baseline values [mean (SD)]	Mean change[a] (95% CI)	P	P-value[b]
6MWD, meters	1	138	407 (119)	59 (40, 78)	<0.001	
	≥2	175	386 (120)	92 (75, 109)	<0.001	0.01
BMI, kg/m^2	1	152	35.69 (8.79)	0.19 (−0.29, 0.67)	0.43	
	≥2	195	34.92 (7.75)	−0.22 (−0.72, 0.29)	0.40	0.26
Weight, kg	1	153	99.29 (26.43)	0.46 (−0.72, 1.65)	0.44	
	≥2	198	96.92 (23.80)	−1.24 (−2.62, 0.14)	0.077	0.08
WC, cm	1	152	114.17 (19.17)	−1.83 (−3.29, −0.36)	<0.015	
	≥2	195	112.86 (16.14)	−1.76 (−3.06, −0.47)	0.008	0.95
HC, cm	1	151	119.35 (18.30)	−1.30 (−2.86, 0.27)	0.10	
	≥2	187	118.42 (15.87)	−0.96 (−2.32, 0.41)	0.17	0.75
WHR	1	149	0.96 (0.10)	−0.008 (−0.020, 0.003)	0.14	
	≥2	186	0.95 (0.09)	−0.007 (−0.016, 0.003)	0.17	0.81

CI, confidence interval; BMI, body mass index; WC, waist circumference; WHR, waist to hip ratio; 6MWD, 6-min walk distance; HC, hip circumference.

[a] Positive values represent increases, negative values represent reductions.

[b] Between-group difference in mean change.

Table 5 – Correlations of 6MWD change and anthropometric changes.

Health measurement	Percent of change from baseline			
	Bivariate model		Multivariate model[a]	
	Coef. (95% CI)	P	Coef. (95% CI)	P
BMI	−0.16 (−1.10, 0.77)	0.73	−0.14 (−1.07, 0.79)	0.77
WC	−1.37 (−2.47, −0.27)	0.015	−1.33 (−2.42, −0.24)	0.017
WHR	−0.87 (−2.17, 0.44)	0.19	−0.87 (−2.17, 0.42)	0.18

Coef., coefficient; CI, confidence interval; BMI, body mass index; WC, waist circumference; WHR, waist to hip ratio; 6MWD, 6-min walk distance; CI, confidence interval.

[a] Adjusted for age, gender, the number of pre-existing chronic conditions, and the number of cycles attended.

rural/remote communities.[4,9,20,21] The WIO program is the only health program targeted at urban residing Aboriginal and Torres Strait Islander people with one or more chronic conditions that offers ongoing participation and tracks a number of health measurements throughout. Findings of this study confirm improvement of 6MWD through one-off participation in the WIO program. Further, the findings suggest greater benefits when participating in the program for more than one cycle. Considering that participants of the WIO program live with an average of six chronic conditions, these findings are particularly encouraging. Moreover, a number of studies, which engaged community dwelling elders,[22] people with chronic obstructive pulmonary disease,[23] heart failure,[24] and stroke,[22] have identified that clinically minimal important differences for clinical prognosis or mortality risk were indicated by improvements of 6MWD by 19–54 m. Thus, the overall improvement of 6MWD in this study is likely to have important clinical significance in improving the general health status and reducing mortality risk in this population. Future studies are warranted to follow WIO participants and non-participants longitudinally for health outcomes, which will provide prospective evidence of such effects.

Anthropometric changes resulting from physical and educational intervention studies among Indigenous people have generally not been consistent.[20] However, D'Onise et al. suggests even modest weight or WC loss may predict potentially large clinical benefits in a remote Indigenous population of Australia.[25] Previously, evaluation studies found a little or no change in WC and BMI in small samples and over one-off intervention periods.[20,21,26,27] Swift et al. claimed that physical activities or exercise training can associate with significant health benefits and limited weight loss for participants with or at risk of cardiovascular diseases.[28] Longitudinal investigations in Australian adults (25–75 years) from 1992 to 2007 revealed substantial gain in weight, WC, and BMI over time in males and averagely larger gain in females than males.[29] A study that followed up a group of Indigenous women aged 15–34 years from 1999 to 2000 found an average annual increase of 0.5 kg/m^2 in BMI, 1.5 kg in weight, 1.6 cm increase in WC in Aboriginal women as well as 1.2 cm increase in WC in Torres Strait Islander women.[30]

Given these previous findings, weight maintenance rather than gain is an important result in this study as it indicates a slowdown of the national trend of weight gain. WC, HC, and WHR were likely to decrease slightly, which suggests minor changes in body fat distribution after participation in the program. The results of this study also demonstrate promise in modest and statistically significant reduction in the highest tertile groups for all observed anthropometric measures.

Furthermore, results of bivariate and multivariate linear regression models showed negative correlations between percent of change in 6MWD and WC. However, the associations between change of BMI or WHR and 6MWD were not statistically significant. Previous literature suggests that WC

could be a better indicator for cardiovascular burden and all-cause mortality than BMI in both the general population and Indigenous people.[15,16,31] Findings of this study support that WC may be a sensitive indicator of functional exercise capacity. Therefore, it is recommended to closely monitor patient's WC change in clinical and epidemiological studies among Australian Aboriginal and Torres Strait Islander people. This finding may have important clinical significance in predicting participants' exercise capacity as well as clinical prognosis.

This study used data collected from an ongoing chronic disease self-management program, which included a relatively large sample of urban Aboriginal and Torres Strait Islander people. More than half of the participants in this study actively participated in the WIO program for two or more cycles. The findings of this study adds insightful information on both one-off and recurring effects of an exercise and education combined chronic disease self-management program for urban Indigenous people in Queensland.

There were some limitations in this study. This is not a randomized controlled trial study, which is considered the most rigorous method to evaluate interventions. However, it is invidious to not offer an intervention to Indigenous people at-risk who may be benefit from the intervention.[26] The lack of a control group means it is unable to confirm whether the changes identified in this study are attributable to spontaneous improvement over time. While the large sample size provides some confidence, further studies could compare a matched sample of clients who chose not to participate in the program as a control group. Second, not all participants completed all measurements. Participants who have higher number of pre-existing chronic conditions are more likely to miss out one or more measurements. Older participants are also more likely to miss out the 6-min walk test. As a result, the estimated changes may be over-represented by younger and healthier participants. Third, previous studies have identified a learning effect for the 6-min walk test, which may explain part of the 6MWD change in this study.[32] In this study, the effect may be attenuated because the review assessments were conducted at least 12 weeks apart from the initial assessment. Fourth, although standardized measurement protocols were applied, measurement error must be considered. As protocols and instruments were kept consistent across measurements over time, errors are likely to be similar across assessment occasions, mitigating the effect of error on change over time. Last but not least, we acknowledge that regression to the mean may be a limitation which could possibly explain the significant change in the third level of respective baseline values. However, the premeasurements and postmeasurements were conducted at least 12 weeks apart and may be conducted by different person. Moreover, results showed unanimous increase in 6MWD in all three tertile groups.

Nevertheless, the WIO program has been on for more than 5 years and has expanded to 15 locations across Queensland. It is striving to be flexible and culturally accommodating to the Indigenous community. A dose-response relationship study is needed to verify more attendance of the WIO program may result in larger improvement in the health measurements.

Conclusion

In conclusion, this study demonstrated significant improvement in exercise capacity and modest changes in anthropometric measurements among the WIO participants. WC could be used as an indicator for exercise capacity as WC change was significantly correlated with 6MWD change. Findings could be useful for guiding and improving clinical practice of chronic disease self-management programs in Aboriginal and Torres Strait Islander people of Australia.

Author statements

Acknowledgments

The authors would like to thank all WIO participants and staff for their involvement and contributions in the research activity. The authors would specifically like to thank Dr Lyle Turner for commenting and editing the manuscript.

Ethical approval

This study was approved by the Ethics Committee at The University of Queensland (2011001283).

Funding

This project was supported by funds from the Australian Department of Health and Queensland Health.

Competing interests

None declared.

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