LEEDS METROPOLITAN UNIVERSITY
INSTITUTE FOR HEALTH AND WELLBEING

CYCLE4HEALTH:

The evaluation of a 12-week cycling intervention and its impact on health

ctc the national cycling charity

Prepared by:

Institute for Health and Wellbeing

Faculty of Health and Social Sciences

Leeds Metropolitan University

Reader Information

This report was prepared by Stephen Zwolinsky and Professor Steve Robertson.

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Contact Details:

Stephen Zwolinsky,

Centre for Men's Health,

Institute for Health and Wellbeing,

Leeds Metropolitan University,

80 Woodhouse Lane

Leeds,

LS2 8NU

Phone: 0113 812 4359

Email: S.Zwolinsky@leedsmet.ac.uk

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Executive Summary

This document was prepared to provide an overview of the interim findings from *'Cycle4Health'*; results are generated for data that was collected up to 15th October 2013. Data indicated that the intervention was well-targeted attracting a range of participants, and improving many important lifestyle behaviours.

Summary of Key Findings

This box highlights a selection of the key findings emerging from *'Cycle4Health'*. A range of participants adopted interventions and provided data for analysis.

- ***Demographics:*** Adopters were predominantly female, white British, had a mean age of 50 and were not in paid employment.
- ***Physical Activity:*** Over 88% of adopters were in low or moderate activity categories at baseline. On average, they did 1175 MET-minutes/week of physical activity.
- ***Diet:*** Over 88% of adopters did not consume the recommended daily amount of fruit and vegetables at baseline.
- ***Body Mass Index (BMI):*** The majority of adopters presented with an unhealthy BMI, over 60% were overweight or obese.
- ***Cycling Habits:*** Over 80% of adopters did no cycling prior to engaging in interventions and cycled for less than 15 minutes on average each week.

Over the course of the *'Cycle4Health'* intervention, a number of positive changes were detected. Data indicated statistically significant improvements in:

- ***Physical Activity:*** Completers displayed a mean increase of 1218 MET-minutes/week of physical activity at follow-up.
- ***Cycling Time:*** On average, completers were doing an additional 68 minutes of cycling per week at follow-up.
- ***Cycling Distance:*** Completers displayed a mean increase of 4.69 miles of cycling per week at follow-up.
- ***Commuting by Bicycle:*** There was a 35.2% increase in the number of completers commuting by bicycle from baseline to follow-up.

Introduction

Participation in physical activity for health improvement has a long history. Pioneering work from the 1950's onwards by, among others, Jerry Morris and Ralph Paffenbarger, paved the way for years of scientific research showing a clear causal connection between activity and health. However, current population levels of physical activity are discouraging. The world health organization has estimated that around two thirds of the world's population are insufficiently active (McKay, 2004). In the UK, over 60% of men, and over 70% of women fall short of achieving the current physical activity recommendations of ≥150 minutes of at least moderate intensity physical activity each week (Department of Health, 2011), despite a raft of evidence showing that important indices of health are responsive to additional energy expenditure.

Studies have estimated the risks of inactivity to be comparable to smoking one packet of cigarettes a day (Rankin, 2012). Yet whilst only 21% of the population smoke, it is common in many countries for a much higher proportion of adults to fall short of contemporary physical activity targets. For this reason, among others, it is alarming the extent to which physical activity is so underutilized as a prevention strategy, let alone as a treatment.

However, persuading individuals to achieve current physical activity recommendations alone is not the *'magic bullet'*. Increasingly, evidence suggests that even when individuals do engage in 150 minutes of moderate intensity physical activity per week, what happens in the remaining 6500 minutes of the waking week is important for health too (van der Ploeg, 2012). Consequently, encouraging lifestyle activity that raises energy expenditure and reduces morbidity and mortality is an attractive prospect for public health.

Cycling/active travel is one form of physical activity that holds such potential. Although walking can be a more achievable form of active travel for some groups, cycling may be more likely to raise the heart rate sufficiently to improve cardiorespiratory fitness (Yang, 2010). Further, cycling appears to be a time efficient and feasible form of daily activity that may be attractive to some portions of the population. This document outlines the interim findings from the evaluation of *'Cycling4Health'*, a 12-week cycling based intervention.

Methodology

This section summarises the methodology employed in the evaluation, highlighting the methods used to capture, measure and analyse the data. *'Cycle4Health'* is an intervention designed to increase participation in cycling, and improve the health profiles of participants. Self-reported data collection tools for demographics, lifestyle behaviours and cycling habits were designed and refined with staff at *'Cycle4Health'.* Data was collected at baseline and at 12-week follow-up. The short form international physical activity questionnaire (IPAQ) was used to gather activity data. This tool has been shown to be valid and reliable with adult populations (Craig, 2003). Further, self-reported measures of physical activity and energy expenditure are sensitive enough to predict changes in activity (Haskell, 2012).

Following ethical clearance, once collected, data were inputted into the statistical software package SPSS (v19) for analysis. Percentages were calculated from the total number of valid answers given for a question. In addition to generating descriptive statistics, inferential analyses were conducted (where appropriate) to explore the relationship between variables of interest. Unless otherwise stated, a p value of 0.05 or less was taken to be statistically significant. Variations in the sample size were found for variables when compared to the number of adopters and completers who engaged the *'Cycle4Health'* evaluation. Given the small sample sizes of some sub groups of adopters and completers, the percentage breakdowns and results of the inferential tests based on these sub groups should be treated with caution. Inferential tests based on small sample sizes potentially lack sufficient power to detect a statistically significant difference.

A range of key terms are used to differentiate between data sets, and participants throughout this report. The term *'Baseline'* refers to data that was collected from participants when they first engaged the intervention. The term *'Follow-Up'* refers to data captured from participants when they completed the intervention, typically at 12-weeks. *'Adopters'* are those participants who provided data at *'Baseline'*; *'Completers'* are those participants who provided data at *'Baseline'* and again at *'Follow-Up'*. Essentially, *'Completers'* are a sub-sample of *'Adopters'* that finished the evaluation.

Results

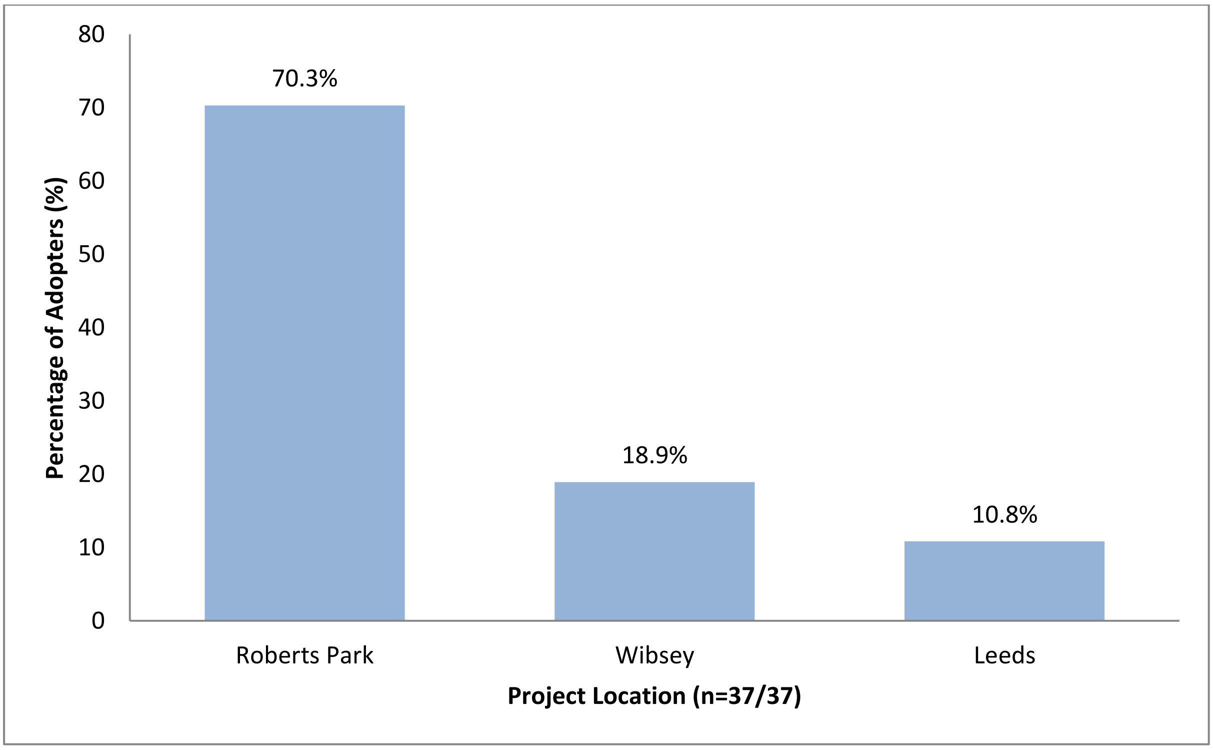
Participants Adopting Interventions –

(i) Adopters: Demographics

<u>Intervention Site:</u>

In total n=37 adopters engaged interventions delivered by *'Cycle4Health'* and provided data for analysis. Three different sites, located at 'Roberts Park', 'Wibsey' and 'Leeds' delivered cycling based physical activity interventions. The site at 'Roberts Park' attracted the highest proportion of adopters with over 70% (n= 26/37) of the total sample attending this venue. The site at Leeds attracted the fewest adopters 10.8% (n=4/37), but this was due, in part, to the comparatively late start of the data collection process at this site, which did not begin till mid-September 2013.

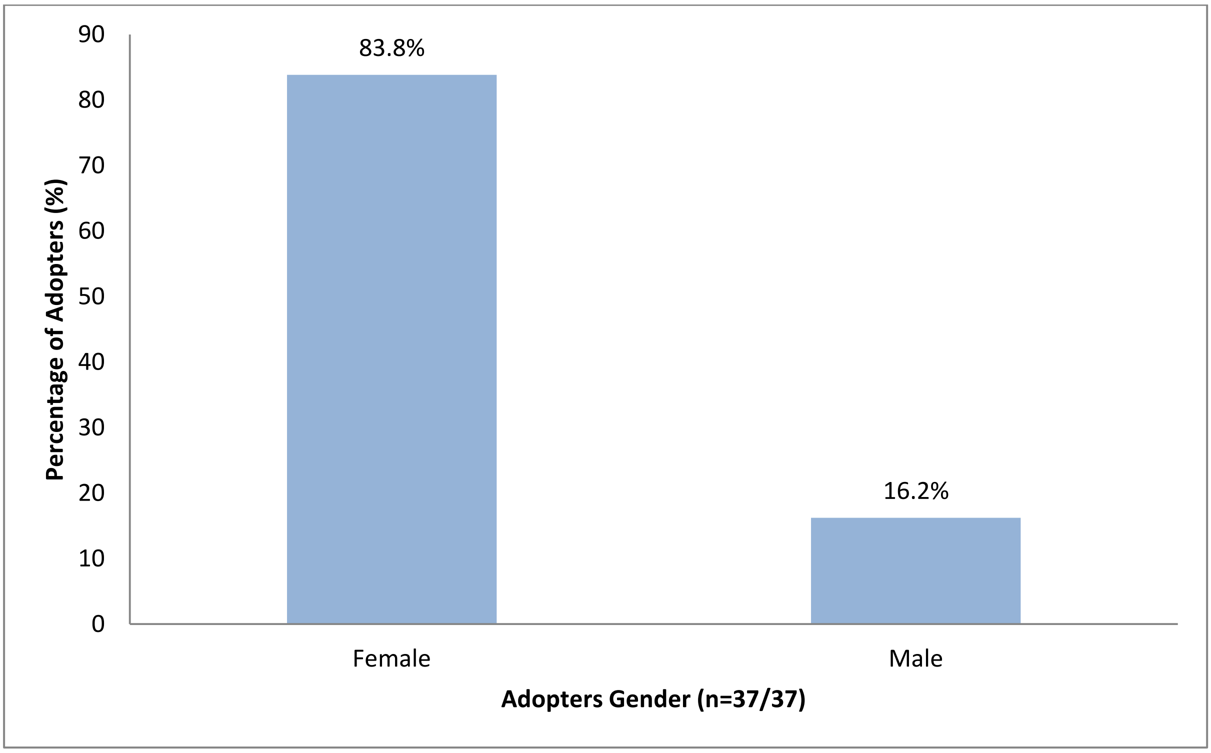
Figure 1: *'Cycle4Health'* Project Locations and Attendance



Gender:

In total n=37 adopters provided information on gender. Male and female adopters engaged *'Cycle4Health'* interventions across all three sites. As figure 2 highlights, a high proportion of the total sample was female (83.8%, n=31/37). Moreover, a higher proportion of females compared to males attended each individual intervention site, however, there was no statistically significant difference in gender by intervention site (U=87.500, p=0.778) which suggests that this breakdown was common across the piece.

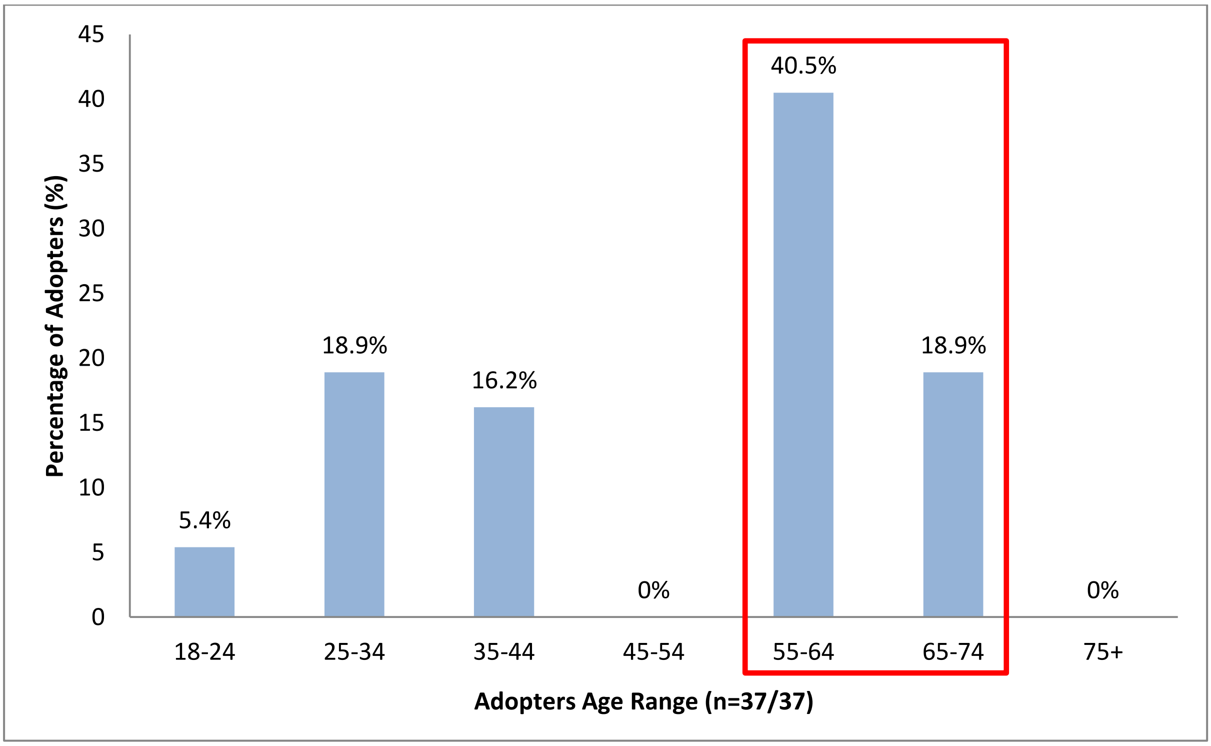
Figure 2: Adopters Gender



Age:

In total n=37 adopters provided data on age. For all adopters, the mean age was 50.03 (±15.721) years. Age ranged from 18-73 years with an inter quartile range of 34.5-62 years. As figure 3 indicates, around 60% (n=22/37) of adopters were aged 55-74 years, pointing to an older sample. There were no statistically significant differences in age by project site ($F[2, 34]=2.893$, p=0.069) suggesting that age was similar across all three sites. However there were statistically significant differences in age by gender ($t[22.6]=4.153$, p=0.000). Analysis highlighted that male adopters (62.83 years [±5.707]) had a higher mean age when compared to female (47.55 years [±15.846]) adopters.

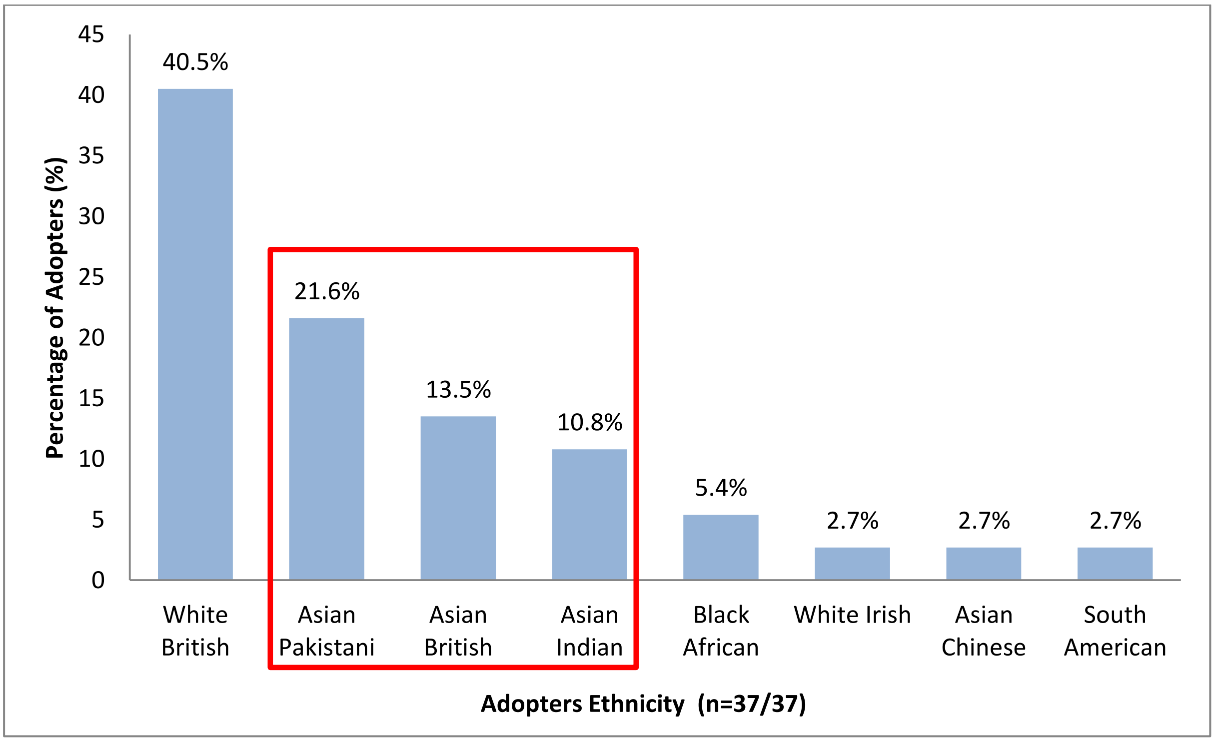
Figure 3: Adopters Age



Ethnicity:

In total n=37 adopters provided data on ethnicity. *'Cycle4Health'* attracted a diverse sample, yet over 40% (n=15/37) of adopters were White British. This represented the single largest ethnic group of all the adopters, but is markedly lower than the white British population of the local areas. However, Asian Pakistani, British and Indian adopters collectively accounted for around 46% (n=17/37) of the total sample. Although this sample was ethnically diverse, it was dominated by White and Asian adopters.

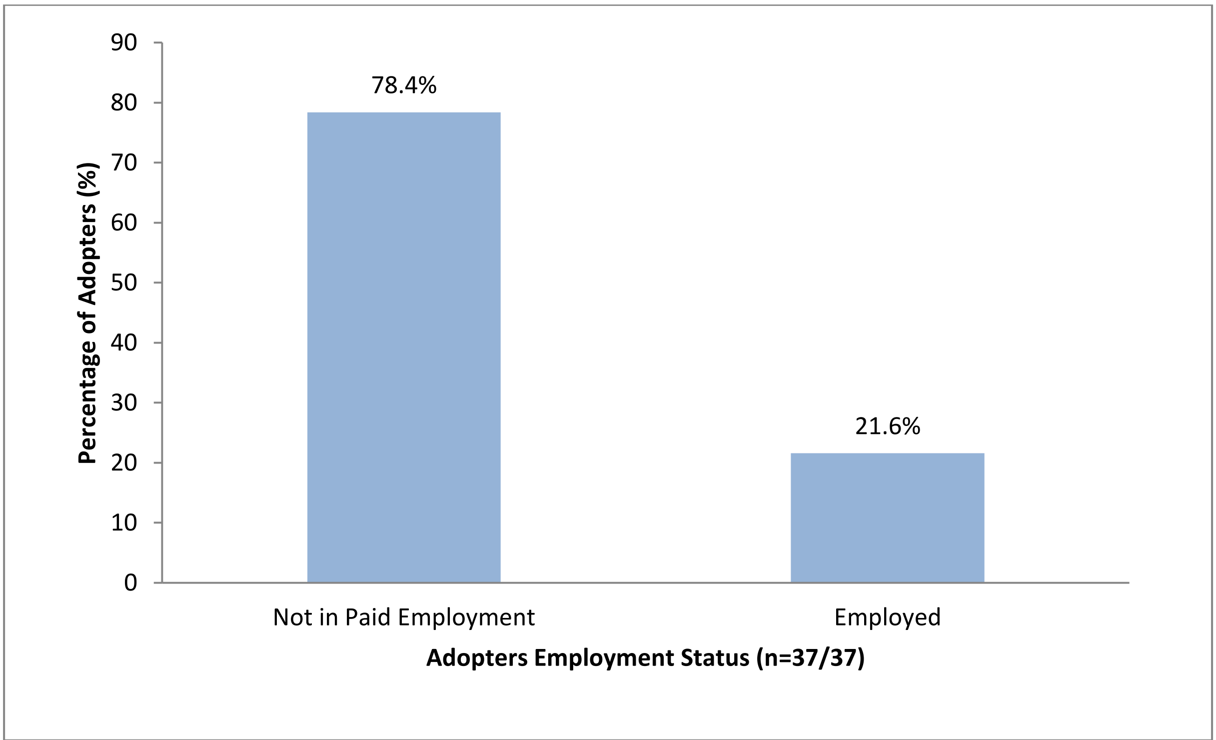
Figure 4: Adopters Ethnicity



Employment:

In total n=37 adopters provided data on employment. Figure 5 shows that the majority of adopters (78.4%, n=29/37) were not in paid employment. In part, this may be due to the age of the cohort, a substantial proportion were of retirement age. There were no significant differences in employment status by age range (U=94.000, p=0.396), but the highest proportion of employed adopters were aged between 55-64 years (33.3%, n=5/15). Further, males had a higher proportion of employed adopters (33.3%, n=2/6) when compared to females (19.4%, n=6/31), yet this difference was not statistically significant ($\chi^2[4]=4.985$, p=0.298) suggesting that employment levels did not differ significantly by gender.

Figure 5: Adopters Employment Status

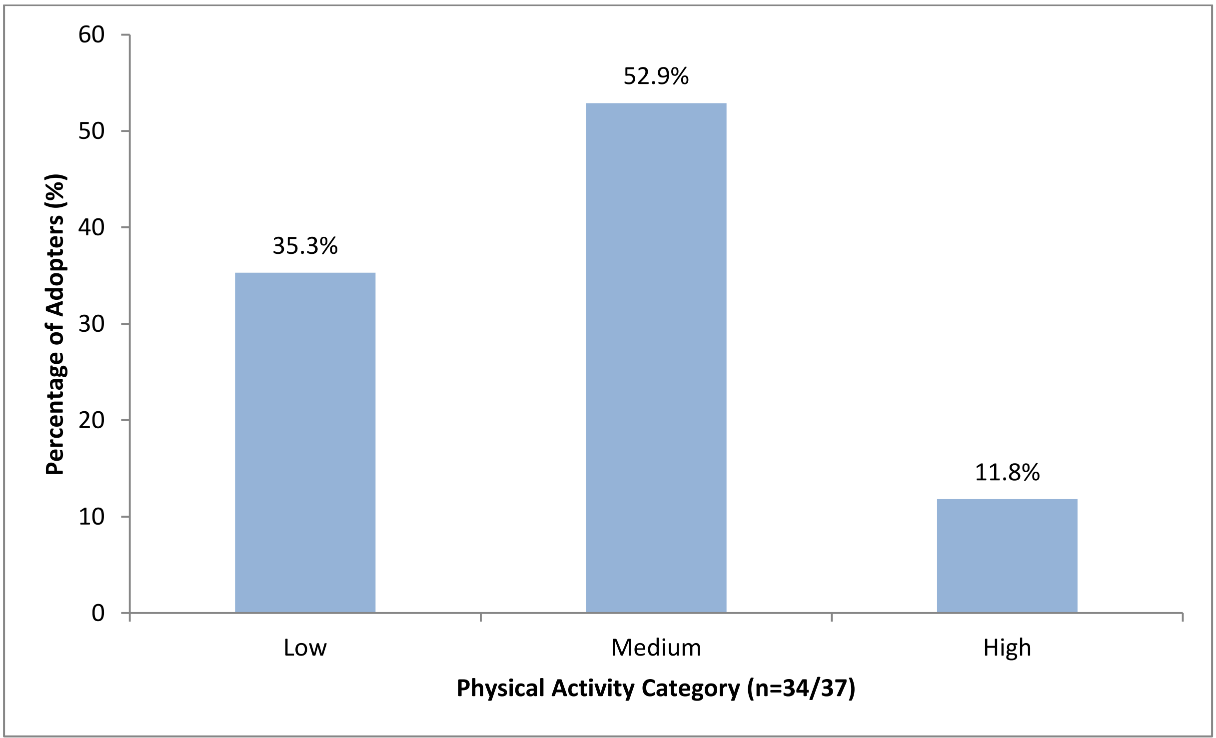


(ii) Adopters: Lifestyle Behaviours & Risk Factors

Physical Activity:

In total n=34 adopters provided data on physical activity. The mean MET-minutes/week expenditure for all adopters was 1175 (±1106.9). MET-minute/week expenditure ranged from 18-4200 with an inter quartile range of 487.50-1485. To put this in perspective, if these MET values were converted in to comparable cycling time, at baseline, adopters would have been doing the equivalent of 59.36 (±55.904) minutes of cycling at 10-12mph (6 MET intensity) per week. Figure 6 shows that the majority of adopters were moderately active (52.9% n=18/34), however, there were a substantial proportion of adopters in the low physical activity category (35.3%, n=12/34). Further, there were no statistically significant differences in MET-minutes/week expenditure by gender (t[32]=0.403, p=0.690), age range (F[4, 29]=1.185, p=0.338) or employment status (t[32]=0.417, p=0.679).

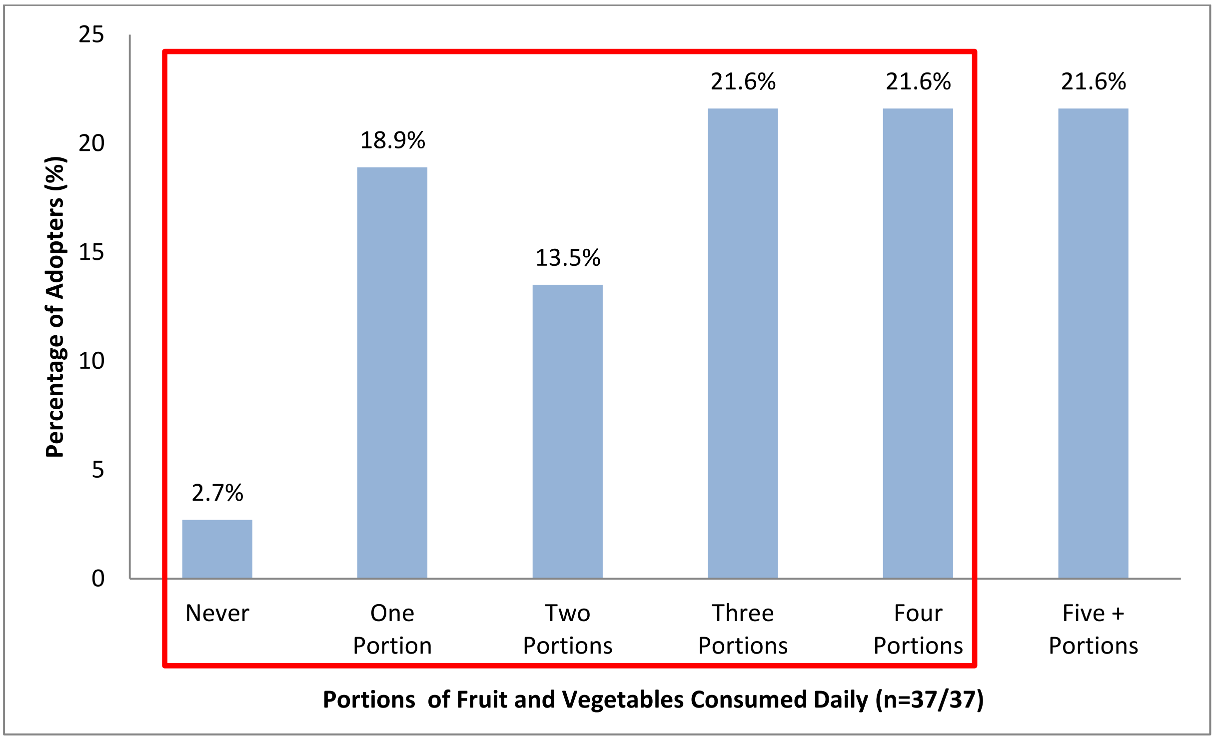
Figure 6: Adopters Physical Activity Category



Fruit and Vegetable Consumption:

In total n=37 adopters provided data on daily fruit and vegetable consumption. National guidance recommends that adults consume five or more portions of fruit and vegetables each day. The majority of adopters, over 88% (n=29/37), did not consume the recommended amount per day and were therefore at a greater risk of various chronic health conditions. However, over 64% (n=24/37) consumed three or more portions daily. Further, there were no statistically significant differences in the number of adopters meeting national fruit and vegetable guidelines (5 portions a day) by gender (U=103.00, p=0.453) or employment status (U=102.500, p=0.485).

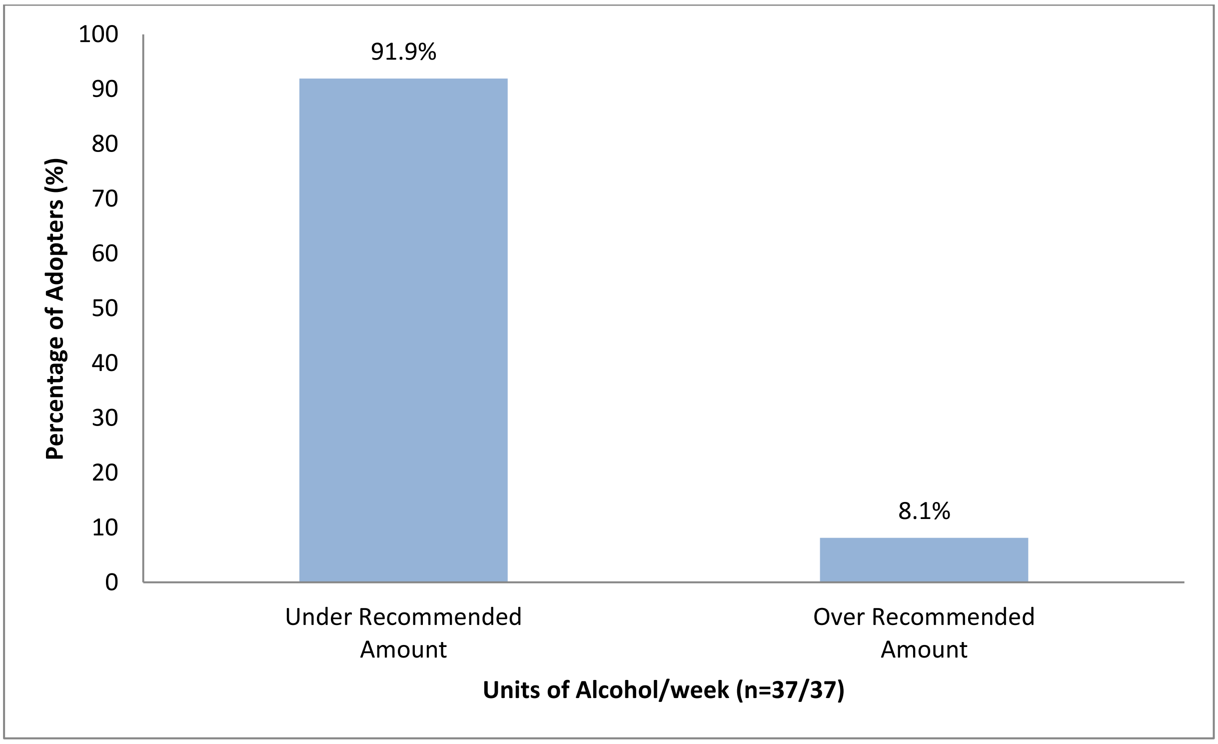
Figure 7: Adopters Daily Fruit and Vegetable Consumption



Smoking and Alcohol Consumption:

In total n=37 adopters provided data on smoking, all 37 adopters (100%) reported that they did not smoke cigarettes. In addition to this, n=37 adopters provided data on weekly alcohol consumption, of these, over 75% (n=28/37) did not drink alcohol at all. Government recommendations state that adult males should not exceed 21 units of alcohol per week, and women should not exceed 14 units of alcohol per week (ONS, 2010). Figure 8 shows that the vast majority of adopters, nearly 92% (n=34/37), drank alcohol within these limits. However, of those adopters that did drink alcohol, over 33% (n=3/9) exceeded the recommendations. Further, of the men providing any data on alcohol consumption, none reported exceeding 21 units/week, and just under 10% (n=3/31) of women exceeded their guidelines (14 units/week). There were no statistically significant differences in alcohol consumption by employment status (U=44.500, p=0.612).

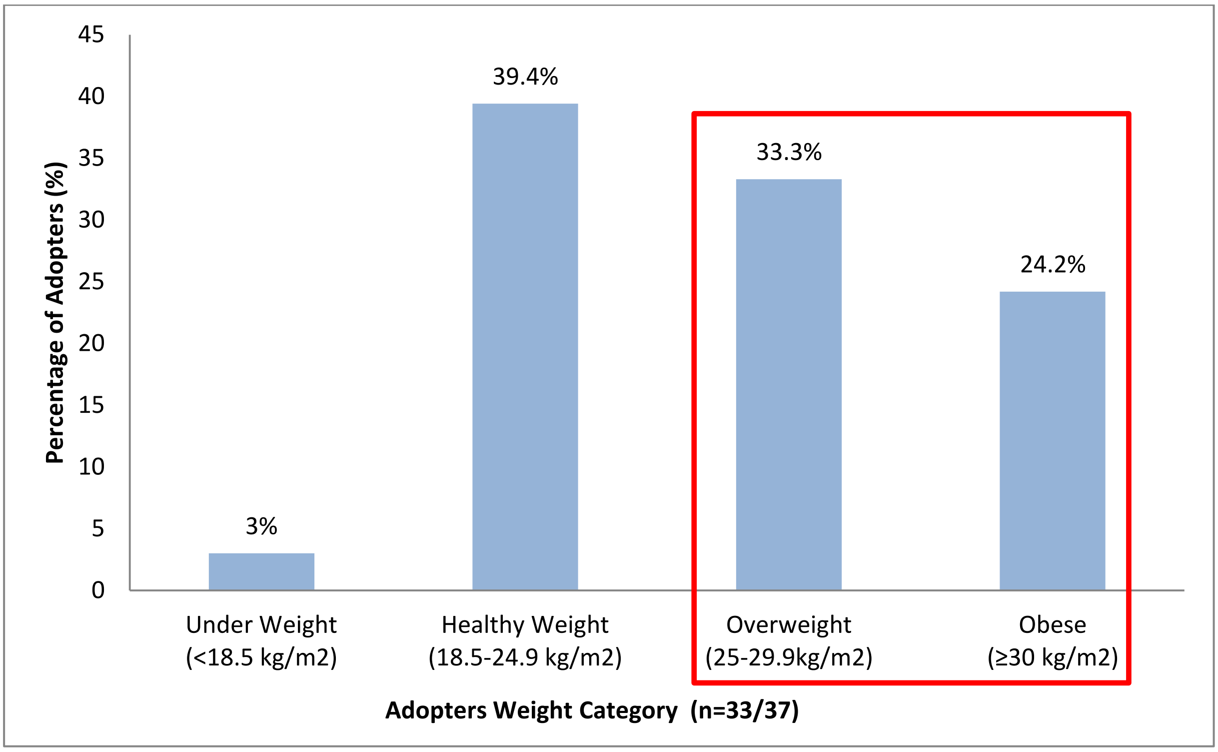
Figure 8: Adopters Weekly Alcohol Consumption (Units/week)



Body Mass Index (BMI):

In total n=33 adopters provided data on BMI. BMI is a person's weight in kilograms divided by the square of their height in meters (kg/m^2). It is one of the most commonly used ways of estimating whether a person is of a healthy weight, overweight, obese or underweight. Having a healthy weight reduces the risk of developing diseases such as coronary heart disease, type 2 diabetes, osteoarthritis and some cancers (NICE, 2012). The mean BMI of adopters was 27.67 kg/m^2 (±5.932). BMI ranged from 18.3-43.2kg/m^2, with an interquartile range of 23.10-30.10 kg/m^2. The majority of adopters were in an unhealthy weight category, nearly 60% (n=19/33) were either overweight or obese. Additionally, there were no statistically significant differences in BMI by gender (t[28.7]=-1.574, p=0.126), although mean BMI was slightly lower in men (25.40 kg/m^2) compared to women (27.68 kg/m^2). Further, there were no significant differences in BMI by employment status (t[31]=0.773, p=0.446), or by physical activity category (F[2, 27]=0.671, p=0.520).

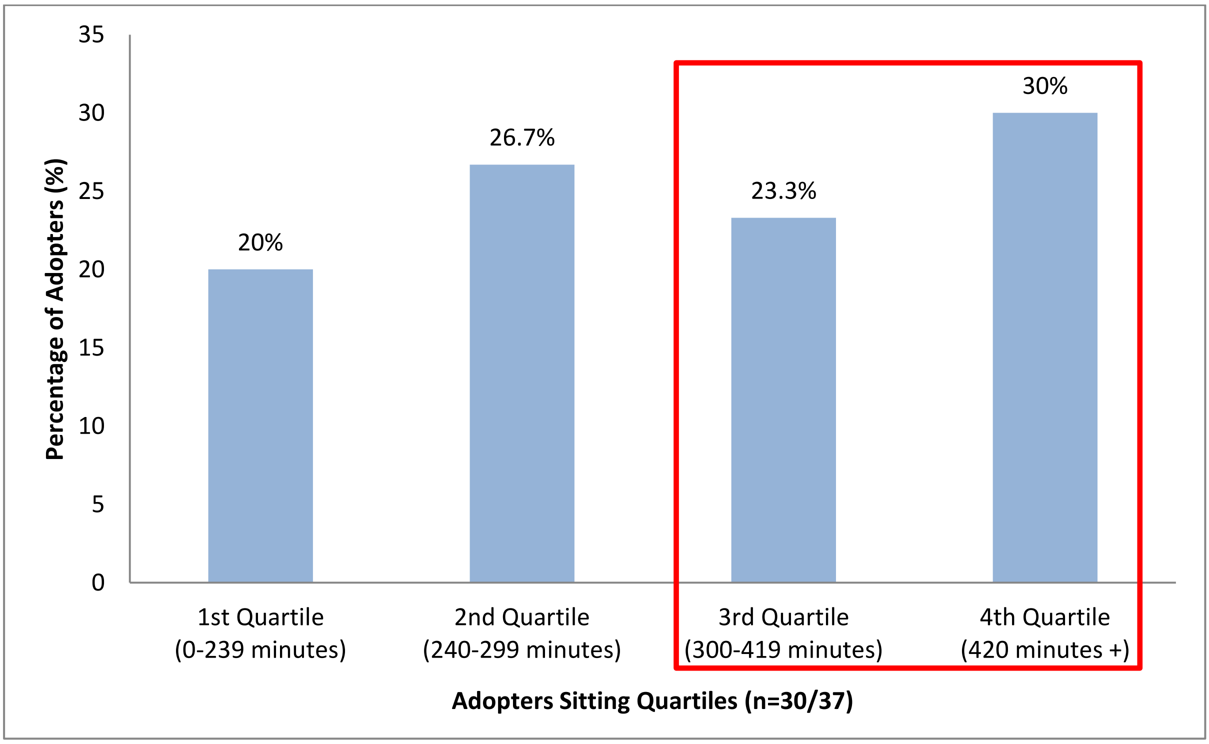
Figure 9: Adopters Weight Categories



Sitting Time:

In total n=30 adopters provided data on sitting time. Prolonged sitting, independent of time spent in physical activity, is associated with all-cause mortality, CVD, obesity, type 2 diabetes, poor bone health and metabolic syndrome (Ford, 2012). Mean daily sitting time was 320 (±156.2) minutes/day, or five hours and twenty minutes. Daily sitting time ranged from 60-780 minutes/day with an inter quartile range of 240-420 minutes/day. Over 50% (n=16/30) of adopters sat for at least five hours per day, and only 20% (n=6/30) sat for less than four hours per day. There were no statistically significant differences in daily sitting time by gender ($t[28]=0.543$, p=0.591), employment status ($t[28]=-0.172$, p=0.864) or physical activity category ($F[2, 25]=0.737$, p=0.488).

Figure 10: Adopters Sitting Quartiles

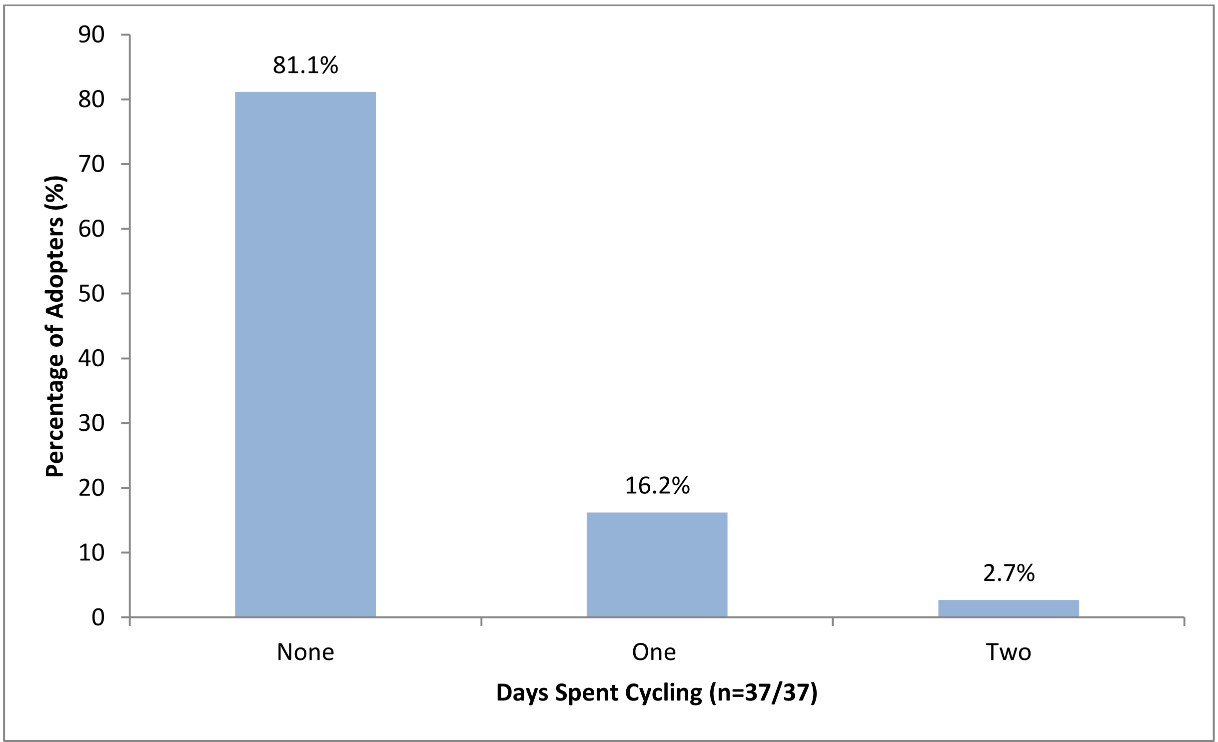


(iii) Adopters: Cycling Habits

Cycling Habits:

In total n=37 adopters provided data on their cycling habits. Figure 11 shows that over 80% (n=30/37) of adopters did no cycling each week before engaging the *'Cycling4health'* intervention, and only 2.7% (n=1/37) cycled more than once per week. The mean time spent cycling per week was under 15 minutes, and the mean distanced cycled per week by adopters was 1.06 (±0.596) miles. Further only 2.7% (n=1/37) of adopters used a bicycle to commute to work during the week.

Figure 11: Adopters Days Spent Cycling per Week



Participants Completing Interventions –

(i) Completers: Demographics

In total n=17 participants provided data at 12-week follow-up and completed the *'Cycle4Health'* evaluation. This was 45.9% (n=17/37) of the total sample and indicates an attrition rate of 54.1% to the evaluation. However, at the time of this report, all potential follow-up data may not have been captured and this figure may improve.

<u>Demographic Profiles:</u>

In total n=17 completers participating in interventions provided data for analysis on their demographic profiles. The site at 'Roberts Park' attracted the highest proportion of completers with over 88% (n=15/17) attending this venue. Further, given the proportion of adopters (70%, n=26/37) attending this site, it would appear that 'Roberts Park' was the best attended venue and saw the most participants through the evaluation. No completers came from the Leeds site. Completers were represented by a higher proportion of females (88.2%, n=15/17) compared to males (11.8%, n=2/17), which was very similar to the gender split at baseline. For all completers, the mean age was 55.59 years (±13.996). Age ranged from 32-73 years with an interquartile range of 40.0-65.5 years. Over 70% of completers were aged 55-74 years indicating an older sample of completers. Male completers had a higher mean age (69.5 years) compared to women (53.7 years), and completers had a higher mean age compared to adopters. As far as ethnicity was concerned, White British completers accounted for 58.8% (n=10/17) of the sample, which was 18% higher than the proportion at baseline. Completers of an Asian decent accounted for 35.4% (n=6/17). Further, the majority of completers were not in paid employment (70.6%, n=12/17).

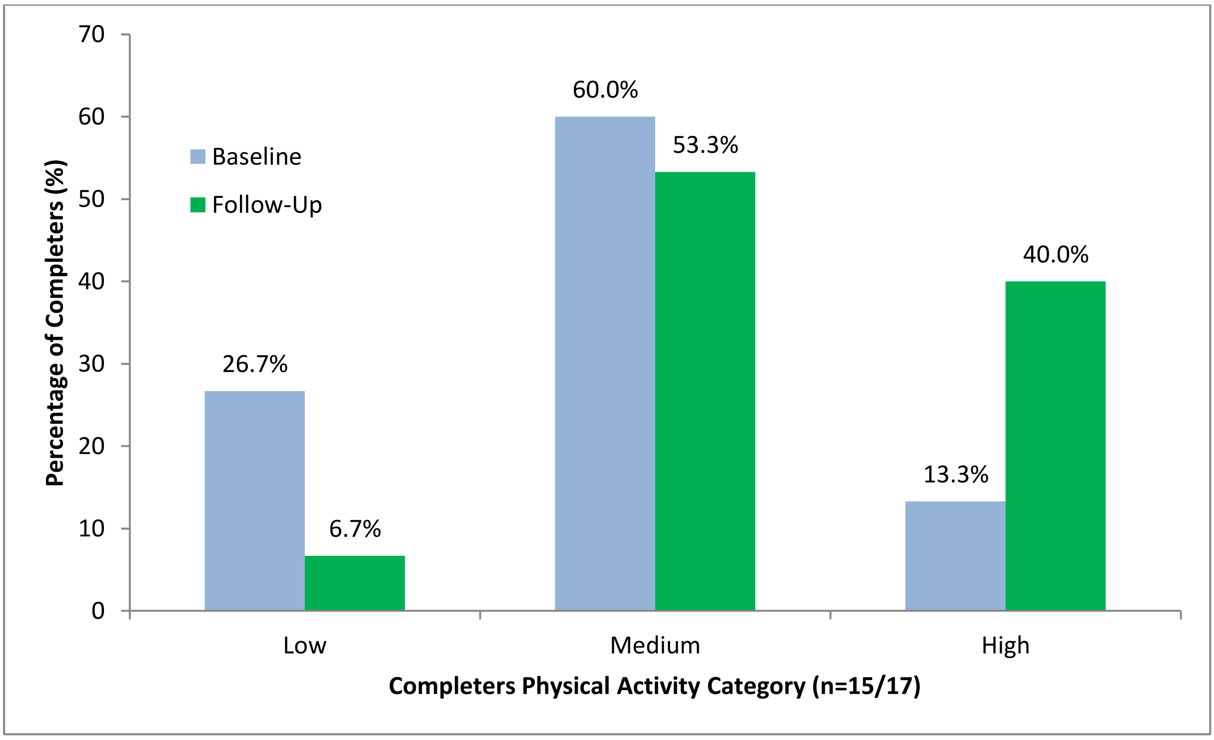
In summary, the demographic profile of completers was broadly similar to the adopters, with few major differences; the main variances were witnessed for age and ethnicity. Completers were predominantly older, White British, females not currently in paid employment attending sessions at 'Roberts Park'.

(ii) Completers: Lifestyle Behaviours and Risk Factors

Physical Activity:

Physical activity data was provided by n=15 completers. The mean MET-minutes/week expenditure for completers at follow-up was 2520 (±1860.2). MET-minute/week expenditure at follow-up ranged from 255-6720 with an inter quartile range of 810-3840. There was a statistically significant increase, 1218 (±1288.7) MET-minutes/week, from baseline to follow-up for *'Cycle4Health'* completers (*t*[14]=3.662, p=0.003). Converting these MET values in to comparable cycling time, at follow-up, completers were undertaking the equivalent of an additional 61.54 (±65.087) minutes of cycling at 10-12mph (6 MET intensity) per week. Figure 12 shows that the majority of completers were in the moderately active category at baseline (60%, n=9/15), and follow-up (53.3%, n=8/15). Moreover, 40% (n=6/15) of completers were in the high activity category at follow-up, which was a 26.7% increase from baseline. Overall, there were statistically significant improvements in physical activity category (Z=-2.646, p=008) from baseline to follow-up.

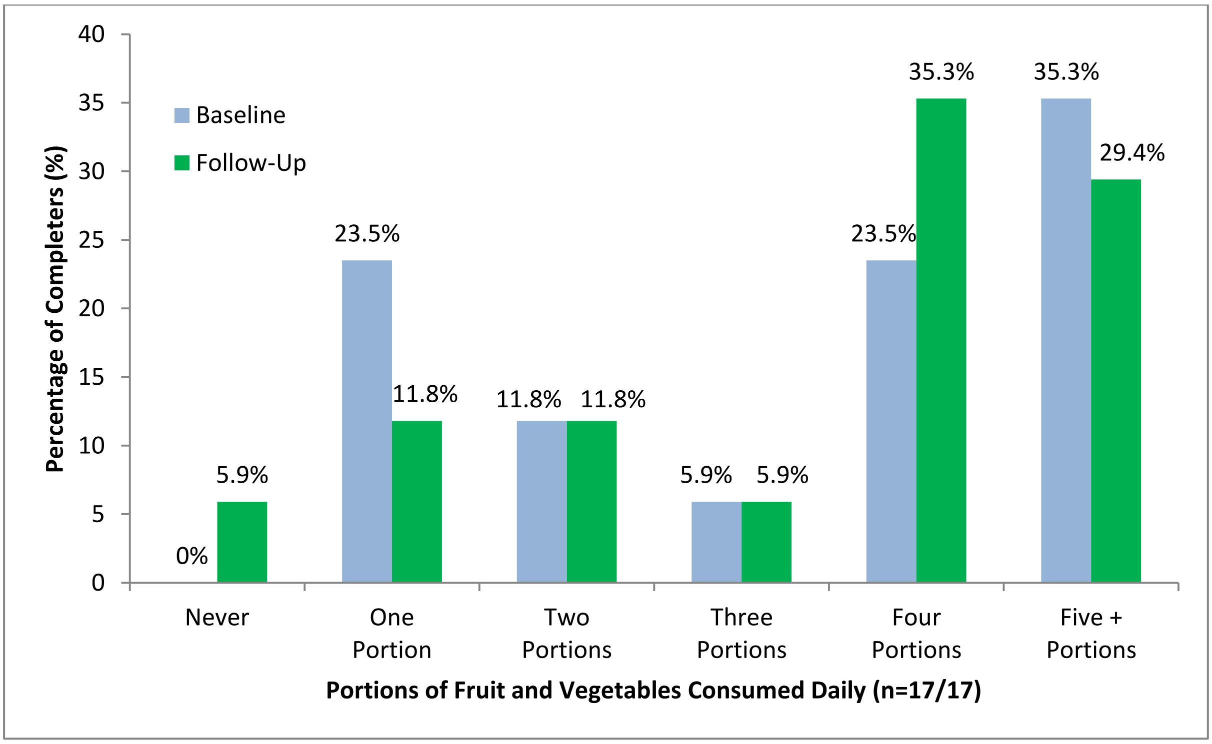
Figure 12: Change in Completers Physical Activity Category



Fruit and Vegetable Consumption:

Data on daily fruit and vegetable consumption was presented by n=17 completers. The majority of completers, around 65% (n=11/17), did not consume the recommended amount of fruit and vegetables per day at baseline, and this figure actually increased to 30.6% (n=12/17) at follow-up. Further, there was a 5.9% (n=1/17) increase in completers not consuming any fruit and vegetables each day. As figure 13 shows, daily consumption of fruit and vegetables actually declined over the course of the intervention, although this was not statistically significant (Z=0.000, p=1.000). Furthermore, there was no statistically significant difference in the proportion of adopters eating the recommended amount of fruit and vegetables each day from baseline to follow-up (Z=-0.577, p=0.564).

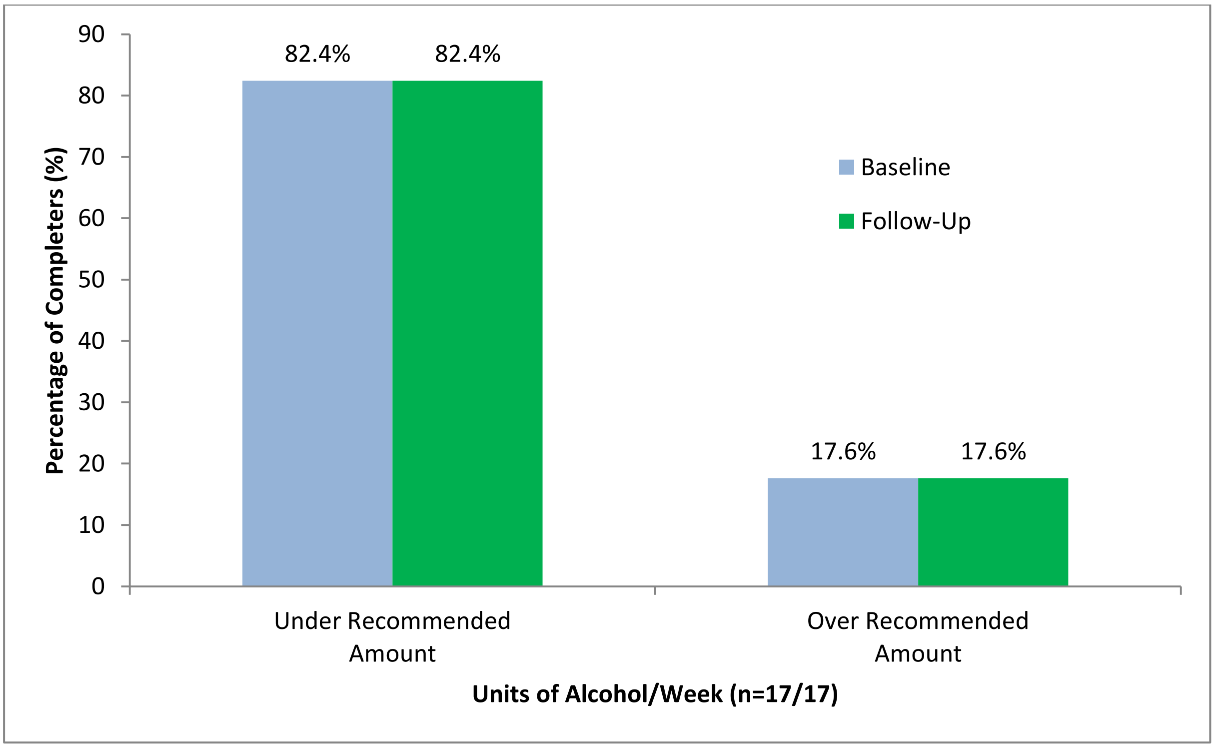
Figure 13: Change in Completers Daily Fruit and Vegetable Consumption



Smoking and Alcohol Consumption:

In total n=17 completers provided data on smoking, all 17 adopters (100%) reported that they did not smoke cigarettes at baseline, this figure was replicated at follow up. In addition to this, n=17 adopters provided data on weekly alcohol consumption, of these, nearly 53% (n=9/17) of respondents did not drink alcohol at all. Figure 14 shows that the vast majority of adopters, over 82% (n=14/17), drank alcohol within the recommended weekly amount. Mean weekly alcohol consumption for completers was 7.40 (±12.430) units/week at baseline and 5.49 (±7.841) units/week at follow up. Although completers reduced their alcohol intake over the intervention period, this difference was not statistically significant ($t[16]=1.504$, $p=0.152$).

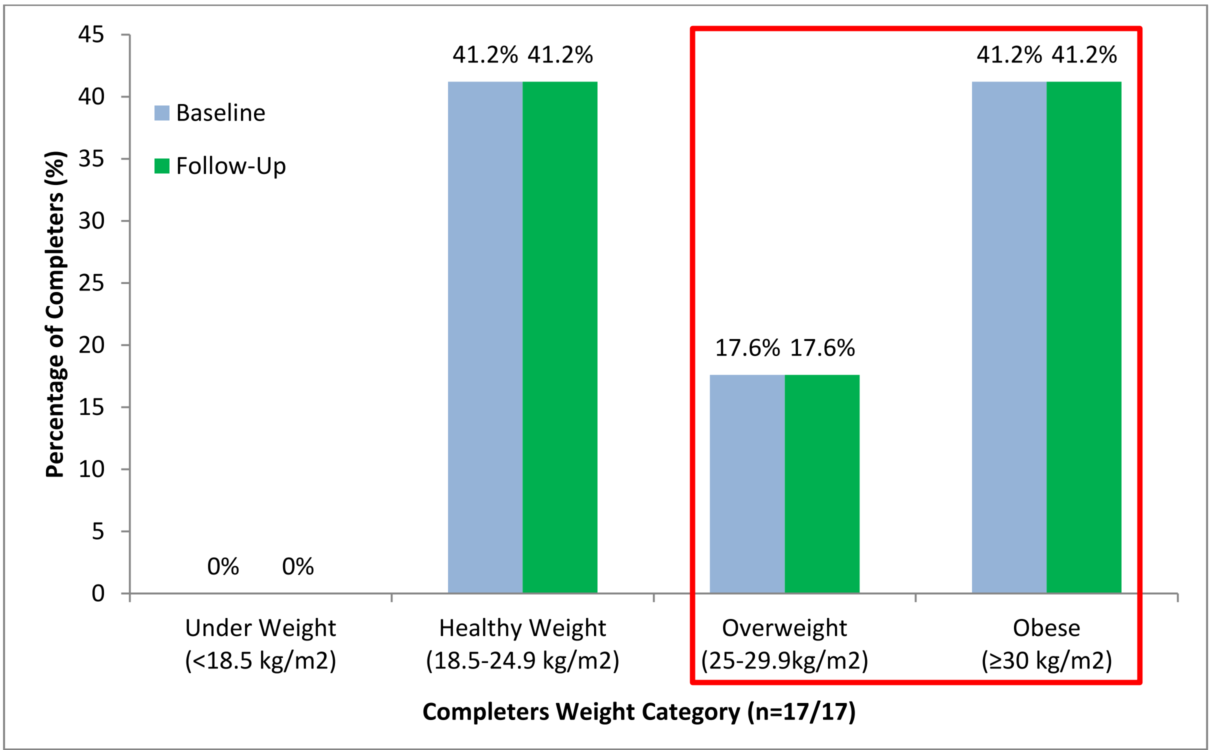
Figure 14: Completers Weekly Alcohol Consumption (Units/week)



Body Mass Index (BMI):

Data on BMI was provided by n=17 completers. The mean BMI for completers at follow-up was 27.84 kg/m^2 (±6.686). BMI at follow-up ranged from 20.0-42.7kg/m^2, with an interquartile range of 21.95-34.40 kg/m^2. As figure 15 shows, the majority of completers were in an unhealthy weight category, nearly 69% (n=10/17) were either overweight or obese at baseline and follow-up. Additionally, there was a slight increase in BMI, 0.737 (±1.3904) kg/m^2, from baseline to follow-up for *'Cycle4Health'* completers, although this difference was not statistically significant (t[15]=2.122, p=0.051).

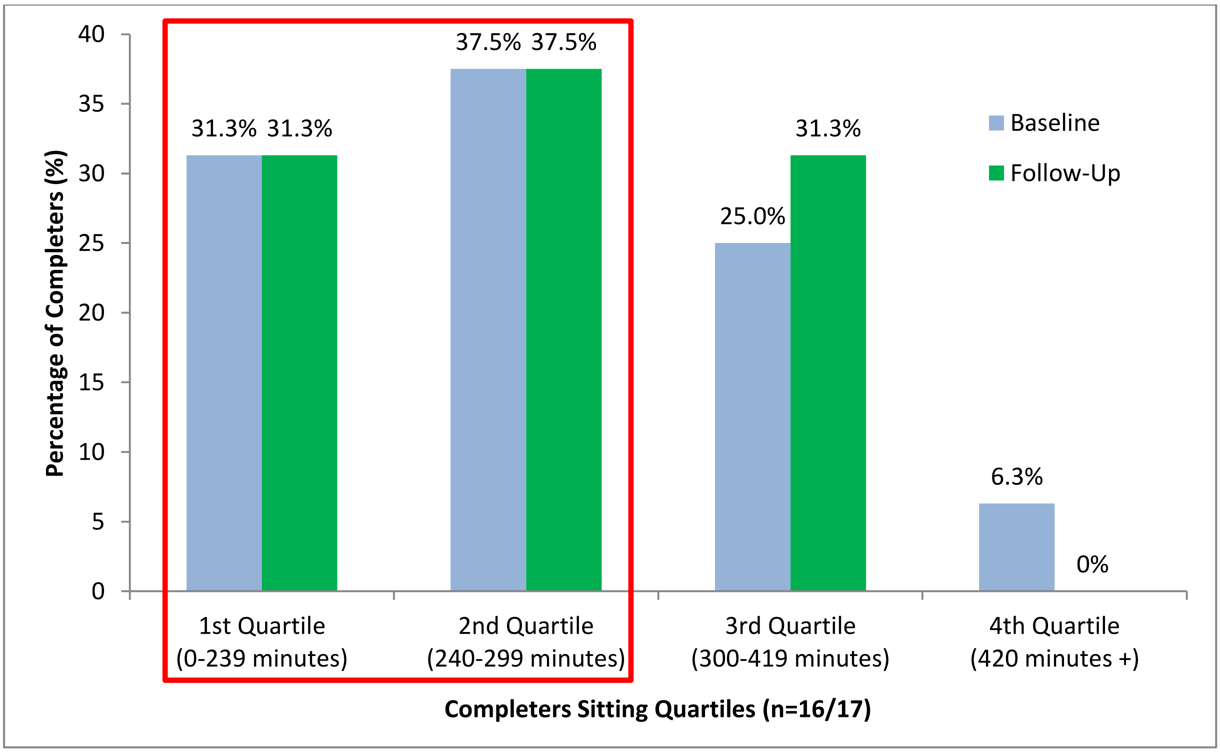
Figure 15: Completers Weight Categories



Sitting Time:

Data on sitting time was provided by n=16 completers. The sitting quartiles used in the analysis of completers data are the same as those calculated for adopters. As figure 16 shows the majority of completers, 68.8% (n=11/16), sat for less than five hours per day at baseline and follow-up. Further only 6.3% (n=1/16) of completers sat for more than seven hours per day at baseline, and no completers were in this quartile at follow-up. Mean daily sitting time at follow-up was 247.5 (±72.24) minutes/day, or four hours and eight minutes. Daily sitting time at follow-up ranged from 120-360 minutes/day with an inter quartile range of 180-300 minutes/day. Although there was a slight decrease in mean sitting time from baseline to follow-up (11.25 minutes/day), this difference was not statistically significant (t[15]=0.436, p=0.699).

Figure 16: Completers Sitting Quartiles

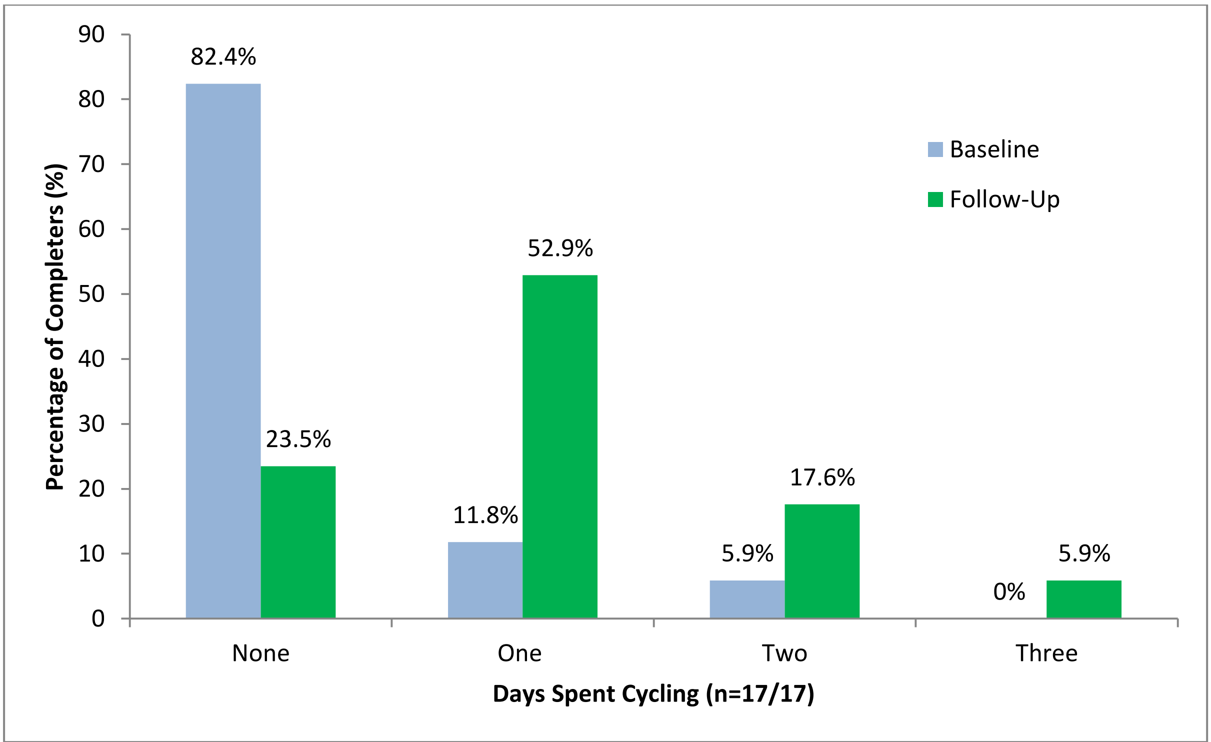


(iii) Completers: Cycling Habits

Cycling Habits:

Data on cycling habits was provided by n=17 completers. Figure 17 shows that over 82% (n=14/17) of completers did not cycle at all before engaging *'Cycling4health'*, and only 5.9% (n=1/17) cycled more than once per week. At 12-week follow-up these figures had improved, 23.5% (n=4/17) did no cycling each week, and 23.5% (n=4/17) cycled more than once per week. Further, only 5.9% (n=1/17) of completers commuted by bicycle at baseline compared to 41.1% (n=7/17) at follow-up, this represented a statistically significant improvement (Z=-2.460, p=0.014). Mean distance cycled for completers at follow-up was 6.85 (±10.090) miles/week which, compared to baseline, was a mean increase of 4.69 (±5.765) miles/week. Mean cycling time for completers at follow up was 87.94 (±85.422) minutes/week, and represented a 68.52 (54.134) increase in weekly cycling time – or one hour and eight minutes. Statistically significant increases in weekly cycling distance (t[12]=2.935, p=0.012) and time (t[16]=5.220, p=0.000) were observed over the course of the *'Cycling4Health'* interventions.

Figure 17: Completers Days Spent Cycling per Week



Conclusions-

'Cycling4Health' appears to be a well-targeted intervention; it attracts a diverse range of participants in need of health intervention across three different sites. In general, demographic profiles highlighted that adopters were largely female, aged 55-74, white British and not currently in paid employment. As a whole, adopters presented with health profiles similar to those you would expected from such a demographic make-up. Nearly 90% of adopters were in the low or moderate activity category, on average, this equated to less than one hour of cycling at 10-12mph per week. Further, a similar proportion did not meet national recommendations for fruit and vegetable consumption placing them at greater risk of various chronic health conditions. Yet, more promisingly, over 90% of adopters did not exceed alcohol recommendations and no one reported being a current smoker. However, the majority of adopters presented with an unhealthy weight category, and sat for prolonged periods throughout the day indicating poor adherence to lifestyle activity. On top of all this, most adopters undertook no cycling prior to engaging *'Cycling4Health'* and cycled, on average, for less than 15 minutes per week which attests to the potential of a cycling based intervention.

At 12-week follow-up, the demographic composition of the completers was broadly similar to that of the adopters. Further, a number of positive changes were detected. Completers reported statistically significant improvements in physical activity (MET-minutes/week) compared to baseline. Increases in activity are associated with enhanced health profiles which, for example, can be generated through improved lipoprotein profiles, carbohydrate metabolism, lower blood pressure and weight loss (Blair, 1996). Additionally, data indicated statistically significant improvements in cycling time, distance cycled per week and commuting by bicycle. These increases in cycling and commuting have the potential improve important markers of health given that cycling can elicit intensities above the threshold of cardiovascular adaption (de Geus, 2007). Data also highlighted reductions in daily sitting time and alcohol consumption (units/week). Even though these improvements were not statistically significant, it suggests an intervention effect for lifestyle behaviours other than physical activity, which in itself, is important. Lastly, although there were no statistically significant changes in fruit and vegetable consumption and BMI, these were the only variables to regress for completers over the course of the intervention.

Taking all this in to account, whilst the evaluation of *'Cycling4Health'* elicited some interesting and positive findings, it is important to remember that recruitment to the evaluation, and absolute sample sizes were relatively small. Consequently, given these parameters, the results need to be treated with some amount of caution. Further, the data are also based on self-report which may be subject to participant bias and socially desirable responses, therefore, an unknown level of misclassification may also have occurred.

In Summary, *'Cycling4Health'* was a well-targeted intervention attracting a range of participants who improved many important lifestyle behaviours. Based on these findings, a number of key learning points can be gleaned. Given the relative success of the site at 'Roberts Park', tacit knowledge and experiential learning, gained here, and also at other sites, should be disseminated to improve and refine best practice across *'Cycling4Health'*. Any future work may benefit from a refined approach to engagement to help attract more males, and younger employed individuals. Further, adding a lifestyle component (diet and weight management specifically), to the intervention may help to improve adherence to contemporary lifestyle recommendations.

References

Blair, S. Kampert, J. Kohl, H. 3rd, Barlow, C. Macera, C. Paffenbarger, R Jr., et al. (1996). ***Influences of cardiorespiratory fitness and other precursors on cardiovascular disease and all-cause mortality in men and women.*** JAMA, 17; 276 (3):205-10.

Craig, C. Marshall, A. Sjostrom, M. Bauman, A. Booth, M. Ainsworth, B. Pratt, M. Ekelund, E. Yngve, A. Sallis, J. & Oja, P. (2003). ***International Physical Activity Questionnaire: 12 Country Validity & Reliability.*** Medicine and Science in Sports and Exercise, 35 (8): 1381-1395.

De Geus, B. De Smet, S. Nijs, J. Meeusen, R. (2007). ***Determining the intensity and energy expenditure during commuter cycling.*** British Journal of Sports Medicine, 41, 8–12.

Department of Health (2011). ***Start Active, Stay Active: A report on physical activity for health from the four home countries Chief Medical Officers.*** London: Department of Health.

Ford, E. Caspersen, C. (2102). ***Sedentary behaviour and cardiovascular disease: a review of prospective studies.*** International Journal of Epidemiology, 41: 1338-1353.

Haskell, W. (2012). ***Physical Activity by Self-Report: A Brief History and Future Directions.*** Journal of Physical Activity and Health, 9 (Suppl 1): S5-S10.

MacKay, J. Mensah, G. (2004). ***The Atlas of Heart Disease and Stroke.*** World Health Organization (WHO) & Centres for Disease Control and Prevention, Geneva, pp. 1–116.

National Institute of Health and Clinical Excellence (2012). ***Obesity: Working with local communities.*** **NICE Public Health Guidance 42.** London, National Institute of Health and Clinical Excellence.

Office for National Statistics (2010). ***Opinion survey report No 42, Drinking: adults' behaviour and knowledge in 2009.*** London: Office for National Statistics.
Available at: http://http://www.statistics.gov.uk/downloads/theme_health/drink2009.pdf;2010

Rankin, A. Rankin, AC. MacIntyre, P. Hillis, WS. (2012). ***Walk or run? Is high-intensity exercise more effective than moderate-intensity exercise at reducing cardiovascular risk?*** Scottish Medical Journal, 57(2):99-102.

van der Ploeg, H. Chey, T. Korda, R. Banks, E. Bauman, A. (2012). ***Sitting Time and All-Cause Mortality Risk in 222 497 Australian Adults.*** Archives of Internal Medicine, 172 (6): 494-500.

Yang, L. Shalqvist, S. McMinn, A. Griffin, S. Ogilvie, D. (2010). ***Interventions to improve cycling: Systematic review.*** British Medical Journal, 341:c5293.