Introduction

Cardiovascular disease (CVD) is the second highest cause of death in the UK, accounting for 28% of all deaths (BHF, 2014). Five main risk factors are associated with CVD; smoking, alcohol, increased blood pressure, increased cholesterol and obesity (Mackay et al., 2004). In 2012-2013 £6.8 billion was spent on CVD within the National Health Service (NHS) of which 63% was spent on secondary care and 21% on primary care (BHF, 2014). Obesity is a large contributing risk factor to CVD and 62% of adults are classed as being overweight or obese (NOO, 2014). A fundamental cause of obesity alongside diet is physical inactivity with only 58 and 51 % of men and women over 35 years, completing the recommended guidelines for Physical Activity (PA), respectively (BHF, 2015). Due to these figures the Department of Health (DoHE) for England created the 'Health Check' scheme for 40-74 year olds in 2009; designed to decrease morbidity, mortality and other health implications as a consequence of CVD, type 2 diabetes and chronic kidney disease (DoH, 2008).

Dalton et al.,(2011a) reported that only 44.8% of high risk CVD individuals that were invited for a Health Check took this opportunity to visit their General Practitioner (GP). It was also reported that younger individuals and smokers were the least likely to uptake the programme, with the most likely to complete the Health Check were; South Asian/mixed ethic background, pre-diagnosed hypertension, females (Artac et al., 2013a) and those from smaller practices (Dalton et al., 2011a). From the data collected by the Health Check programme, it has been reported that 23.9% of the eligible population for the scheme will have underlying hypertension and 11.3% will have impaired fasting glucose. Studies have reported reductions between 10% (Stoke on Trent) and 28% (Hammersmith and Fulham) of CVD risk from Health Checks one year apart (Cochrane et al., 2012; Artac et al., 2013a).

Haringey, a borough in London is one of the most deprived authorities in the England. According to the Index of Multiple Deprivation (Communities and Local Government 2010) it was ranked the 13th most deprived authority out of 326 in England, and fourth most deprived borough in London

(Haringey Council, 2015). Furthermore, 80 out of 144 of Haringey's Lower Super Output Areas (LSOA) fall in to the most deprived 20%, with a further 7 of these LSOA fall into 2-3% of the most deprived in England (Haringey Council, 2015). Additionally, men in Haringey have a lower life expectancy than other areas in London (Haringey Council, 2015) and there was an estimated 3,500 individuals with undiagnosed Coronary Heart Disease (CHD) (Tottenham Hotspur Foundation, 2014). Haringey therefore took a unique approach to the NHS Health Checks with their Health team pairing up with a Premier League football club to offer the Health Checks outside of the traditional GP surgery in pop up clinics within the community in an attempt to access hard to reach residents who may have undiagnosed conditions.

The aim of the study was to evaluate obesity and CV risk factors from health check data collected from an inner London borough.

Method

Procedure

Tottenham Hotspur Foundation (THF) was tasked with providing Health Checks between March 2014 and 2015 alongside Haringey council; 3000 were completed. The Health checks were carried out at 25 locations in the east of the borough including supermarkets, public libraries, cultural centres and post offices. Passers-by were approached by the Haringey Health Champions, from the THF and asked to consider completing a Health Check including informed consent for sharing anonymised data. The locations were chosen by THF in conjunction with Haringey council to try and gain a representative community sample and reach at risk populations. Inclusion criteria included being in the age range 40-74 years (Inclusive), a local resident of the east Haringey target postcodes and not had a Health Check in the last 5 years. Exclusion criteria stipulated by NHS Health Check framework was followed including pre-diagnosed (and treated) hypertension, high cholesterol, CKD and CVD.

Data was anonymised and coded prior to releasing it to Middlesex University and stored by THF as per the data protection act following ethical approval from the London sport Institute sub-committee at Middlesex University.

The THF Health Check Practitioner carried out the Health Checks using the dedicated equipment and software based on NHS requirements. A Microsoft Access database was used to stratify risk of patients using NHS Health Check parameter normative values and boundaries. CVD risk factors (blood pressure (BP), body mass index (BMI), total cholesterol (TC), High Density Lipoprotein (HDL), average plasma glucose (HbA1c), smoking status) and demographic characteristics (age, sex, ethnicity) and lifestyle factors (Alcohol use score (AUDIT-C), Fruit and Vegetable intake, General practice physical activity questionnaires (GPPAQ)) for all participants were collected for the risk stratification as per protocol by the trained Health Check practitioner. The Joint British Societies 2 risk score (QRISK2) was applied to the data, as recommended at the time by national clinical guidance (NICE, 2008). Ethnicity was corrected for in the calculation of QRISK2 using the Framingham method (Rondoni et al. 2012).

Participants

3000 Health Checks were completed, however following the application of exclusion criteria (N=209) incomplete (N = 298) and missing data (N=239), the whole group data consisted of N=2254; comprising of 23.4% females (N=529) and 76.6% males (N=1729). The mean age for males was 49.4± 8.0 years and 50.2± 8.0 years for females. The ethnicity breakdown of the sample was; 11.9% White British; 33.5% any other white; 39.3% African, Black and Caribbean; 6.7% white and black African, and Caribbean; 4.7% Indian, Pakistani, Bangladeshi; 3.9% Asian, Chinese and any other.

Data Analysis

Data was coded and anonymised using Microsoft Excel and transferred to SPSS (IBM, version 21) for analysis. Following analysis of the data the Wilks-Lambda Value (0.87 ($p<0.001$)) it suggested that the data was significantly different between male and females and should be analysed as two separate groups.

Outcome measures were classified for analysis using NHS values cited in the literature. For the purposes of this evaluation, obese was defined as having a BMI of ≥30 kgm^{-2}, overweight ≥25kgm^{-2}, normal ≤ 24.99kgm^{-2} and underweight ≤ 19.99 kgm^{-2}. Although the Best Practice Guidance for NHS Health Checks recommend different BMI cut offs for Black and Asian ethnic Backgrounds (NICE, 2014), ethnicity was not the primary focus of this paper and groups unequal so not used for analysis, therefore the standard NHS BMI cut offs were used. Physical activity was grouped into inactive, moderately inactive and active based upon the GPPAQ classification score. Moderately active and active groups were collated due to too few participants in the active (n=153) and moderately active groups (n= 237). TC was classified using boundaries suggested by the NHS, <5mmol/L was normal, ≤6mmol/L, borderline high and ≥6mmol/L high. The age group categories were 40-49 years, 50-60 years and 61 years and older.

Any differences in variables according to age, BMI, Physical Activity (PA) level and TC were examined by four separate Multivariate Analyses of Variances (MANOVA). Bonferroni post hoc analysis was used to identify where any differences were. The cases where BMI, PA and TC were the fixed factor there were six dependant variables in which a Bonferroni correction was p=.05/6= 0.008; for age, there were five dependant variables where a bonferroni correction was p=.05/5= 0.01.

Results

Following analysis of the data the Wilks-Lambda Value was 0.87 ($p<0.001$) and therefore suggested that the data was significantly different between male and females and should be analysed as two separate groups. Descriptive statistics are displayed in Table 1 as mean and 95% confidence intervals.

BMI

Males

Normal and overweight males were significantly older than obese males, F(3,1698) 3.001,p=0.01. Underweight males consumed significantly more alcohol units compared to all other BMI, F(3,1698) 7.774, p<0.001. There was an overall significant main effect between BMI category and the level of plasma glucose (F(3,1698) 177.156, p<0.001). Following the post hoc analysis it identified overweight and obese males had significantly higher plasma glucose level compared to normal and underweight males (p<0.01). Obese males had significantly higher plasma glucose compared to overweight males (p<0.01). Underweight males consumed significantly more portions of fruit and vegetables compared to obese males F(3,1698) 3.865, p=0.009. There was no significant difference between BMI classifications and total cholesterol levels and QRisk (p>0.05).

Females

There was an overall significant main effect between BMI category and the level of plasma glucose (F(3,513) 108, p<0.001). Post Hoc analysis identified that overweight and obese females had significantly higher plasma glucose levels compared to normal and underweight females (p<0.01). Obese females had significantly higher plasma glucose compared to overweight females (p<0.01). There was no significant differences between BMI classifications and age, alcohol intake, total cholesterol, fruit and vegetable consumption and QRisk (p>0.05).

Physical Activity

Males

Inactive and moderately active males had significantly higher plasma glucose levels compared to active males (F(2,1698) 13.783, p=0.000). Inactive and moderately active males consume significantly less portions of fruit and vegetables compared to active males (F(2,1698) 13.99, p=0.000). Inactive and moderately active males have a significantly higher QRisk compared to active males (F(2,1698) 11.255, p=0.000). There was no significant differences between physical activity level and age, total cholesterol and alcohol intake (p>0.05).

Females

Inactive females have are significantly younger compared to active females (F(2,513) 4.402, p=0.01). Inactive and moderately active females consume significantly more plasma glucose compared to active females (F(2,513)12.463, p=0.000). Inactive females consume significantly less portions of fruit and vegetables compared to active females (F(2,513) 4.671, p=0.01). There was no significant differences between physical activity level and alcohol intake, total cholesterol and Qrisk (p>0.05).

Age

Males

Males aged 50-60 year olds had significantly higher cholesterol compared to males over 60 years (F(2,1698) 3.641, p=0.01). There was a significant overall main effect between age category and the level of blood sugar (F(2,1698) 10.187, p=0.000). Post hoc analysis identified that males under 50 years old had significantly lower plasma glucose level compared to males ages 50-60 years and males over 60 years (p<0.01). Males over 60 years had significantly higher plasma glucose compared to males aged 50-60 years (P<0.01). Males under 50 years consumed significantly less portions of fruit and vegetables compared to males between 50-60 years (F(2,1698) 5.657, p=0.004). Males QRisk significantly increases as the age groups increase in age (F(2,1698) 522.416, p=0.000). There was no significant difference between age group and alcohol intake (p>0.05).

Females

Females between 50-60 years old had a significantly higher fruit and veg intake compared to the other age categories ($F(2,513)$ 3.867, $p=0.01$). Females plasma glucose levels significantly increased as the age groups increase ($F(2,513)$ 85.813, $p=0.00$) . There was no significant difference between age group and alcohol intake, total cholesterol and Q risk.

Diabetes risk (HbA1c method, Diabetes UK)

Males

Low risk males have significantly lower total cholesterol ($F(2,1698)$ 3.084, $p=0.01$) and portions of fruit and vegetables ($F(2,1698)$ 4.885, $p=0.008$) compared to males with moderate risk. Low risk males have significantly lower plasma glucose levels (F2, 1698) 424.068, $p<0.001$), age ($F(2, 1698)$ 9.269, $p<0.001$) and QRisk ($F(2, 1698)$ 14.851, $p<0.001$) compared to moderate and high risk males. There was no significant difference between diabetes risk and alcohol intake ($p>0.05$).

Females

Low risk females have significantly lower plasma glucose levels compared to moderate and high risk females ($F(2, 513)$ 85.831, $p<0.001$). Low risk females have significantly less portions of fruit and vegetables compared to moderate risk females ($F(2, 513)$ 3.867, $p=0.01$). There was no significant difference between diabetes risk and alcohol, age, total cholesterol and QRisk ($p>0.05$).

Table should appear here

Discussion

This study has reported the results from the unique approach of conducting NHS Health Checks in partnership with a premier league football club, the Tottenham Hotspur Foundation in pop up clinics throughout the North London Borough of Haringey. Overall, the study trends support much of the existing literature regarding the CV risk factors (Mokdad et al., 2003 and Sullavan et al., 2005). However, interestingly although physical inactivity was significantly linked to Qrisk, BMI classification, total cholesterol and fruit and vegetable intake were not. The results also allude to how CV diseases and obesity are multifactorial and that all the variables measured have reciprocal relationships between them and are interrelated. Therefore, addressing or treating one or more of the factors could have a positive effect on other risk factors resulting in a wider, multidimensional success measure. The results also highlight the need to focus on physical activity rather than just diet related, weight loss interventions.

Alcohol and Underweight

Being underweight or having a low BMI is often overlooked in the public arena and media as a health concern (Robison, 2007) even though it is has well documented links to higher mortality rates. One of the more interesting results found that underweight males consume significantly more alcohol units compared to all other BMI categories. Underweight males, consumed on average 30 more units per day compared to the other BMI categories which would classify them as an alcoholic dependant according to NHS guidelines (NHS, 2016) and suggesting a large proportion of their daily energy came from alcohol. Daily alcohol intake of greater than 25g increases the risk of heart disease, stroke and hypertension (Sarremi and Arora, 2008; Chiva-Blanch et al., 2013). Haringey's alcohol related hospital admissions are higher than the London and England averages (NWPHO, 2013) further highlighting this as an important target group. The underweight males in Haringey consumed an average of 240g per day, compared to the other weight categories who consumed an average of 21g per day suggesting a much increased risk of CVD (Sarremi and Arora, 2005; Chiva-

Blanch et al., 2013). Males in other weight categories fell into the medium drinking range (14-21 units per week) whereas females were low (7-14 units per week) compared to the drinking guidelines in the UK. Weight loss over time in older adults has been reported as a sign of malnutrition (Beck and Ovesen, 1998), which could be the case for the males in this study. However, kcal intake was not recorded but suggests an area for future research and a reason to not overlook the underweight in identifying health risk factors.

The Gender gap

The target population for pop-up clinics in Haringey was 40-74 year old males, due to the deprivation and life expectancy gender gap identified within the London borough (Haringey Council, 2015) and males being more prone to CVD (Cochran et al., 2012). However, women of this age range were also allowed to have the Health Check done resulting in a skewed sample of a 23.4% and 76.6% split of females and males, respectively and statistically different data sets. Irrespective of this gender bias, females exhibited significant differences that were similar to the males in many of the variables. In particular, females reported higher total cholesterol compared to males, which could suggest an increased risk of diabetes and CVD. The data emphasizes that male and females are both at risk and interventions should target both genders not primarily males.

When comparing the health statistics for the population of Haringey assessed to UK reference data, Haringey is below average. The percentage of people classed as overweight or obese was 11 and 4 % higher for females and males respectively, than the UK average (HSCIC, PHE, 2015). A large contributing factor to these figures could be due to 34 and 36 % less females and males respectively, meet the physical activity guidelines compared to the UK average (HSCIC, PHE, 2015). The large amount of people not meeting the PA guidelines in Haringey is alarming and will be a large contributor to many of the risk factors that are associated with obesity and CVD. Therefore, this data should be used to promote PA interventions within the Borough, and areas of similar demographics and deprivation in both genders. Inactivity and moderate inactivity was associated with a higher

Qrisk, blood sugar and BMI compared to active with no further differences with very active. If energy expenditure can be increased and body fat can be lost, research has identified this as a potential cure for cardiovascular risk, hypertension, high cholesterol and blood glucose (Thompson et al, 2003) but the complexity of the situation make this goal, so far, out of reach. The descriptive statistics show that blood glucose (HbA1c), diastolic BP and total cholesterol are on the border of pre-diabetes and high risk. If cardiovascular health was improved and body fat was reduced via physical activity interventions this could result in the reversal of these risks to within normal ranges (Knowler, 2002; Madden et al., 2009). This would then have a positive impact on secondary care from the NHS, reducing the increasingly burdening cost of obesity related complications (BHF, 2014) and diabetes. The data also suggests that looking at physical activity levels on a self-reporting scale could mean identification of potential cofactors without measurement, therefore allowing interventions and advice to be distributed more efficiently.

Ethnicity

The majority of the sample was of an African, Black or Caribbean ethnic origin. It has been reported that individuals from a black background have a greater mortality risk from CHD in comparison to individuals from different ethnicities (Zhu et al., 2005). Additionally, individuals from a black background are at a greater prevalence (60%) of developing type2 diabetes than participants from a white background (Harris., 1990). This suggests that further analysis of the data between ethnic groups should be conducted and that health information and PA interventions could be made more specific to different cultures by targeting community and cultural hubs and practices.

Moving forward

The results present a potentially alarming situation for the future health of Haringey and potentially other similar inner city boroughs. Age differences showed that cholesterol was greater in the 50-60 year olds compared to the over 60's which is unexpected (Singh et al., 2012). Age related changes would suggest that TC should increase with age and therefore the 50-60 year age group could be identified as even more at risk for CVD and diabetes as their age increases. This agrees with the forecasts of increasing cost to the NHS of health related illnesses. Furthermore this suggests that more should be being done to address physical activity and nutrition education at a younger age rather than just those in the greatest Qrisk categories. Males of this age also consumed less fruit and vegetables compounding the suggestion that diet and healthy eating education should be integrated within an intervention and communicated at primary care meetings. The Fruit and vegetables intake, although not significantly related to obesity or PA was much lower when compared to the national average (4.1 compared to 3.1 portions) (National Dietary and Nutrition Survey 2017). The unique approach to the NHS health check has reported data on hard to reach people who may have gone undetected. Therefore, practitioners should use this data to understand the characteristics of similar boroughs and interventions should further highlight diet and physical activity importance when targeting hard to reach populations.

Conclusions

Overall, the older adults of Haringey indicate that obesity and CVD risk factors have a reciprocal relationship and that interventions needs to be implemented to decrease risk in this population. The results discussed above should be used to tailor interventions for the residents of Haringey and similar areas. For example, the alcoholism issue that has arisen amongst the underweight male population within the borough. Furthermore, females are showing similar trends to males and should also be a target population for interventions. Physical Activity interventions should include education about diet and nutrition as well as being tailored for cultural practices and customs.

List of Abbreviations

BMI – Body Mass Index

BP – Blood Pressure

CHD – Coronary Heart Disease

CVD – Cardiovascular disease

GP – General Practitioner

GPPAQ – General Practitioner Physical Activity Questionnaire

HbA1c – Average Plasma Glucose

HDL – High Density Lipoprotein

LSOA – Lower Super Output Areas

NHS – National Health Service

Qrisk – Cardiovascular disease risk

TC- Total Cholesterol

THF – Tottenham Hotspur Foundation

Declarations

Ethical Approval and consent to participate

Consent for sharing of anonymised data for analysis was gained at the start of the Health Check. Data was anonymised and coded prior to releasing it to Middlesex University and stored by THF as per the data protection act following ethical approval from the London sport Institute sub-committee at Middlesex University.

Consent for publication

Not applicable

Availability of data and materials

The datasets analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

Not applicable

Authors' contributions

All Authors were of equal contribution to the paper. All authors have read and approved the final manuscript.

Acknowledgements

The authors of the paper would like to acknowledge Marion Morris from Haringey Council and Ida Blake from THF for the collection of the data.

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