Understanding the drivers of healthy life expectancy in Wales

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Executive Summary:

This dissertation investigates the socio-demographic, behavioural, and health-related determinants affecting self-reported health outcomes in Wales, utilizing data from the National Survey for Wales (NSW) conducted from 2021 to 2023. The study aimed to discover critical factors of poor health by utilising logistic regression models on a representative dataset comprising over 20,000 respondents. It aimed to replicate and enhance a comparable analysis performed in England, focussing specifically on the manifestation of these elements within the Welsh environment.

Key factors such as age, sex, body mass index (BMI), smoking status, alcohol intake, income, and chronic health issues were examined. The research indicated that advanced age (65+), obesity, smoking, and reduced income levels were significantly associated with an increased likelihood of reporting poor health. Chronic health issues, including musculoskeletal and mental health diseases, significantly contributed to adverse health outcomes. Conversely, elevated levels of physical activity and well-being were affiliated with improved health outcomes, underscoring the significance of lifestyle interventions.

The study employed adjusted odds ratios to control for confounding variables, elucidating each factor's independent impact on health outcomes. Forest plots and receiver operating characteristic (ROC) curves were utilised to illustrate the efficacy and precision of the predictive models.

This report underscores significant public health concerns in Wales, especially pertaining to socio-economic and health disparities. The results highlight the necessity for focused treatments, such as smoking cessation initiatives, obesity mitigation strategies, and mental health assistance, especially in underprivileged regions. By tackling these determinants, governments may formulate measures to enhance population health and mitigate health inequities throughout Wales.

This research enhances the existing evidence about the social determinants of health and provides practical recommendations for the development of future health policy in Wales.

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Abstract:

This study examines the socio-demographic, behavioural, and health-related determinants affecting self-reported health outcomes in Wales, employing data from the National Survey for Wales (NSW) spanning 2021 to 2023. Logistic regression models were utilised to examine the associations between these factors and the probability of reporting poor health. The predictors comprised characteristics like age, sex, income, BMI, smoking status, and chronic health issues. The study sought to juxtapose these findings with a comparable analysis performed in England to elucidate discrepancies between the two regions.

The findings indicate that age, obesity, smoking, and mental health conditions substantially affect self-reported health, with older individuals and those with elevated BMI more prone to reporting adverse health outcomes. Chronic diseases, especially musculoskeletal and neurological illnesses, exhibit significant association with adverse health outcomes. Adjusted odds ratios (AORs) were computed to mitigate the impact of confounding variables, thereby elucidating the contribution of each predictor to health outcomes.

The performance assessment via ROC curves confirmed the models' predictive efficacy, exhibiting elevated sensitivity and specificity scores. The results highlight the necessity of tackling critical health habits and socio-economic disparities via focused public health initiatives. This research enhances public health planning in Wales by elucidating the principal factors influencing health disparities and offering a comparative analysis with health trends in England, highlighting the necessity for customised interventions in both regions.

1 Introduction

1.1 Context and Significance of Healthy Life Expectancy (HLE)

Healthy Life Expectancy (HLE) denotes the duration an individual anticipates living in optimal health, free from significant illnesses or disabilities. It serves as a critical public health metric, providing insights into the overall well-being and health of populations. Substantial advancements have been achieved in worldwide life expectancy; nevertheless, health-related life expectancy has not risen correspondingly, leading to prolonged durations of ill health at life's conclusion. The disparity between life expectancy and healthy life expectancy is especially evident in socio-economically disadvantaged regions (Aburto et al., 2020).

Enhancing health literacy and education in Wales has emerged as a public health need, especially considering escalating health inequities among various regions and socio-economic strata. The nation confronts distinct difficulties, including an elevated incidence of chronic illnesses in former industrial regions and pronounced health disparities stemming from socio-economic hardship. Addressing these difficulties necessitates a comprehensive study of HLE determinants and their variations across different groups (McGowan et al., 2021).

1.2 Wales: An Exceptional Public Health Environment

Wales exhibits a unique public health landscape attributable to its industrial heritage, especially in areas like the South Wales Valleys, where former coal mining communities see an elevated prevalence of respiratory ailments and chronic health issues. Socio-economic issues, including financial disparity, healthcare accessibility, and educational inequities, further deteriorate health outcomes. Furthermore, rural regions of Wales encounter difficulties in obtaining healthcare services, resulting in inferior health outcomes relative to urban areas (McGowan et al., 2021; Rehm et al., 2007).

The Well-being of Future Generations (Wales) Act 2015 was enacted to tackle these systemic challenges by advancing long-term health and well-being objectives. This innovative legislation seeks to enhance HLE by emphasising health promotion, mitigating inequities, and encouraging sustainable development (Welsh Government, 2015). Nonetheless, despite governmental initiatives, substantial differences in healthy life expectancy persist, with the most disadvantaged areas exhibiting much lower healthy life expectancy compared to affluent regions (Marmot & Wilkinson, 2006).

1.3 Research Issue

Despite significant advancements in life expectancy, Wales persists in facing an expanding disparity in health-related quality of life among various socio-economic categories. The nation confronts a continual discrepancy between residents of impoverished areas and those in affluent regions, with socio-economic factors significantly influencing health results. Furthermore, Wales industrial legacy, together with its persistent health repercussions, intensifies this disparity, especially with respiratory ailments and other chronic health issues (Wanless, 2006).

Despite existing research on the determinants of Healthy Life Expectancy (HLE) in Wales, a considerable gap remains in comprehending the interplay of various socio-demographic,

behavioural, and health-related factors that affect HLE. Moreover, comparative analyses between Wales and other regions of the UK, including England, are scarce, hindering the formulation of region-specific initiatives designed to address the distinct difficulties encountered by the Welsh populace. Rectifying these deficiencies is essential for the formulation of effective public health policy.

1.4 Objectives of the Research

This study aims to investigate the socio-demographic, behavioural, and health-related determinants that influence self-reported health outcomes and health-related quality of life in Wales. This project analyses data from the National Survey for Wales (NSW) from 2021 to 2023 to identify principal determinants of adverse health outcomes and investigate disparities among various population groups. This research has the following specific objectives:

1. Identifying essential socio-demographic variables (e.g., age, gender, income, deprivation) that forecast self-reported health and health-related life expectancy in Wales.
2. Analysing the influence of health behaviours (e.g., smoking, alcohol intake, physical activity, BMI) on health-related life expectancy across various socio-economic and demographic cohorts.
3. Investigating the influence of chronic health conditions, including respiratory diseases, mental health disorders, and musculoskeletal disorders, on health-related quality of life (HLE).
4. Contrasting the results from Wales with analogous research in England, emphasising regional disparities in Healthy Life Expectancy (HLE) and discerning insights applicable to Welsh public health policy.

1.5 Research Enquiries

This study will explore the following research questions:

1. In Wales, what are the principal socio-demographic determinants affecting self-reported health and health-related quality of life, especially in disadvantaged regions?
2. What is the effect of behavioural factors such as smoking, alcohol intake, and physical inactivity on Self-Reported Health in Wales, and how do these results relate to those from England?
3. What influence do chronic health issues, including respiratory and mental health disorders, exert on health-related quality of life in Wales?
4. How do the determinants of Healthy Life Expectancy (HLE) in Wales contrast with those identified in England, and what ramifications do these disparities hold for public health policy?

1.6 Importance of the Research

This project will enhance comprehension of the determinants of HLE in Wales, supplying evidence to guide public health policies and interventions. This study will address existing research gaps by concentrating on the socio-demographic, behavioural, and health-related factors influencing Healthy Life Expectancy (HLE) in Wales, hence providing insights into region-specific health concerns. Furthermore, the comparison research with England will facilitate the discovery of best practices that can be tailored to the Welsh environment.

The results of this study will be beneficial for policymakers in Wales, especially regarding the formulation of targeted measures to mitigate health disparities and enhance Healthy Life Expectancy throughout the nation. The findings may facilitate the formulation of public health programs designed to alleviate the burden of chronic diseases, encourage healthy behaviours, and enhance access to healthcare services in underprivileged communities (McGowan et al., 2021; Welsh Government, 2015).

2 Background

2.1 Healthy Life Expectancy (HLE) and Its Significance

Healthy Life Expectancy (HLE) is an essential public health metric that indicates the number of years an individual is anticipated to live in optimal health. In contrast to conventional life expectancy metrics, Health-Adjusted Life Expectancy (HLE) incorporates both the quality and duration of life, offering a more holistic perspective on a population's overall well-being (Aburto et al., 2020). As populations age, the need for targeted public health measures to improve both longevity and the quality of extended years becomes increasingly important.

HLE is particularly important in guiding public health policy because it highlights disparities among communities. Reduced Health-Related Life Expectancy (HLE) frequently connects with elevated deprivation, detrimental behaviours, and increased incidence of chronic illnesses. This makes it an essential statistic for assessing the influence of socioeconomic determinants on health outcomes and formulating interventions intended to mitigate health disparities (Rehm et al., 2007).

2.2 Socio-Economic Context of Wales

Wales possesses a distinctive socio-economic setting that profoundly influences HLE. Many regions of the country, historically reliant on heavy industry, especially coal mining, continue to experience long-term economic and health repercussions due to the loss of these sectors. Former industrial regions, like the South Wales Valleys, exhibit elevated unemployment rates, diminished educational achievement, and limited access to healthcare services. These regions are marked by elevated rates of smoking, alcohol intake, and suboptimal food, all of which adversely affect health life expectancy (HLE) (Wanless, 2006).

Conversely, affluent areas in Wales, including Cardiff and certain sections of Monmouthshire, have elevated Healthy Life Expectancy (HLE). This disparity highlights the significant health inequities that exist nationwide. Studies indicate that persons residing in the most impoverished regions of Wales anticipate living up to 16 years fewer in excellent health than those in the least impoverished parts (McGowan et al., 2021). The pronounced disparities in HLE underscore the urgent necessity for focused public health initiatives to tackle socio-economic and health inequities.

2.3 Health Issues in Wales

The public health landscape in Wales is influenced by various specific challenges, many of which are derived from the nation's industrial history. Respiratory ailments, including chronic obstructive pulmonary disease (COPD), are notably common in former mining areas owing to prolonged exposure to deleterious substances (Marshall et al., 2014). Wales contends with a significant prevalence of chronic diseases, including cardiovascular disease, diabetes, and musculoskeletal disorders, particularly impacting persons in economically disadvantaged regions.

Mental health constitutes a significant concern in Wales, characterised by elevated incidences of anxiety and depression, especially in rural and post-industrial areas. Mental health disorders frequently aggravate physical health issues, hence diminishing health-related quality of life in impacted populations (Walsh et al., 2021). Notwithstanding initiatives to enhance mental health care in Wales, access continues to be an issue, particularly in more remote communities.

The Well-being of Future Generations (Wales) Act 2015 was enacted to tackle health concerns by integrating long-term considerations into public policy. This statute mandates governmental entities to strive for the enhancement of social, economic, environmental, and cultural welfare. It emphasizes the reduction of health disparities and the enhancement of healthy life expectancy (HLE) across all demographic categories (Welsh Government, 2015). Nonetheless, although the Act establishes a comprehensive framework for public health planning, considerable obstacles persist in implementing policy effectively, especially in underprivileged and rural regions.

2.4 The Act for the Well-being of Future Generations

The Well-being of Future Generations (Wales) Act 2015 is a significant legislative measure designed to enhance the long-term welfare of individuals in Wales. It delineates seven well-being objectives, encompassing the establishment of a healthier Wales, the mitigation of disparities, and the promotion of sustainable communities. The Act requires public entities to collaborate to attain these objectives, emphasising prevention and early intervention (Welsh Government, 2015).

The Act underscores the necessity of mitigating health disparities and enabling individuals to have healthy and satisfying lives, irrespective of their socio-economic status. This is especially significant in Wales, where health disparities are among the most evident in the UK (Marmot & Wilkinson, 2006). The Act establishes a framework for the integration of health and social care services, improves access to mental health care, and encourages better behaviours.

The Act has been commended for its ambition, but its execution has encountered numerous obstacles. Resource limitations, especially in rural and underprivileged regions, have impeded public entities from fully achieving the objectives of the Act. Moreover, there is an absence of substantial evidence regarding the long-term effects of the Act on Healthy Life Expectancy (HLE) and health disparities, complicating the evaluation of its efficacy (McGowan et al., 2021). This study seeks to enhance the existing knowledge by examining the socio-demographic, behavioural, and health-related determinants of Healthy Life Expectancy (HLE) in Wales.

2.5 Comparative Analysis with England

Although Wales and England encounter similar health issues, such as the rising incidence of chronic diseases and mental health disorders, notable differences are seen in their expression and management. Due to its industrial history, Wales exhibits a higher prevalence of respiratory problems, whereas urban health issues like obesity and lifestyle-related diseases primarily shape England's public health landscape (Marshall et al., 2014).

The Well-being of Future Generations Act in Wales represents a more integrated and long-term approach to public health compared to England's health policies, which focus mostly on short-term, outcome-driven goals. The divergence in policy focus is apparent in the health results of the two countries, with Wales struggling to improve Healthy Life Expectancy (HLE) at a rate equivalent to England, particularly in its most disadvantaged areas (Rees et al., 2012).

The Office for Health Improvement and Inequities (OHID) asserts that comprehending the socio-demographic and behavioural determinants affecting life expectancy is crucial for mitigating inequities and enhancing health outcomes in both countries (OHID, 2023). An examination of the health issues and policy responses in Wales and England provides substantial insights into the effectiveness of public health measures. This study aims to identify insights for improving public health outcomes in Wales by examining the socio-demographic, behavioural, and health-related factors influencing Healthy Life Expectancy (HLE) in both countries.

2.6 Research Deficiencies and Rationale

Although extensive research on HLE has been undertaken across the UK, there is a deficiency of studies particular to Wales that address the distinct socio-economic and health difficulties encountered by the region. Much research predominantly examines the UK as a unified entity, frequently neglecting the regional disparities in health outcomes and the unique issues encountered by Welsh communities (McGowan et al., 2021).

Furthermore, although the Well-being of Future Generations Act establishes a robust legislative framework for enhancing Healthy Life Expectancy (HLE), there is less information regarding the efficacy of its practical implementation. This study aims to fill existing research gaps by examining the determinants of Health-Related Life Expectancy (HLE) in Wales, contrasting them with those discovered in England, and providing insights into the customisation of public health interventions for the Welsh context.

3 Literature Review

3.1 Preface

Health disparities are a continuing challenge in numerous regions, including Wales, where socio-demographic, behavioural, and socioeconomic factors significantly influence health outcomes. To investigate the correlations between these determinants and health disparities, this review systematically analyses pertinent literature through the lens of the Social Determinants of Health (SDH) framework (Marmot & Wilkinson, 2006), emphasizing Healthy Life Expectancy (HLE). The review emphasises significant findings, critiques techniques, and delineates opportunities for further research and public health interventions.

3.2 Socio-Demographic Factors Influencing Health

Socio-demographic characteristics, such as age, gender, income, education, and ethnicity, substantially affect health outcomes. Marshall et al. (2014) conducted a comprehensive study on population aging in Wales, finding that the aging demographic is a significant contributor to health disparities. Wohland et al. (2015) investigated inequalities in health life expectancy (HLE) among several ethnic groups in the UK, revealing diminished HLE in ethnic minorities, including Pakistanis and Bangladeshis, attributed to socio-economic obstacles and inadequate healthcare access.

Aburto et al. (2020) investigated life expectancy trends in Europe and identified increasing differences in life expectancy among socio-economic classes. The authors emphasised the impact of economic inequality on worsening health disparities. Hiam et al. (2017) linked rising death rates in England and Wales to austerity measures that have disproportionately affected the most disadvantaged people. This study highlighted the necessity of protective social services to mitigate health disparities.

3.2.1 Methodological Considerations:

The studies examined predominantly utilise cross-sectional designs, constraining their capacity to ascertain causal links between socio-demographic variables and health outcomes. Wohland et al. (2015) offer significant insights into ethnic health disparities; nevertheless, their dependence on population predictions does not account for any alterations in social policy or healthcare treatments. Marshall et al. (2014) also utilises cross-sectional data, which may inadequately capture the evolving character of health disparities across time. Future research should include longitudinal designs to better understand the evolution and interaction of socio-demographic determinants with health over the course of a person's life.

3.3 Socioeconomic Disparities

According to factors, including income, education, and employment, are recognised determinants of health outcomes, as highlighted by the Social Determinants of Health (SDH) framework (Marmot & Wilkinson, 2006). Kadel et al. (2022) assert that health disparities in Wales impose significant financial burdens on the NHS, mostly due to heightened emergency healthcare utilisation in disadvantaged regions. This aligns with the findings of Rees et al. (2012), who identified demographic shifts. Specifically population aging and rising ethnic

diversity as significant factors contributing to health inequalities unless mitigated by focused interventions.

The Wanless Report (2006) emphasises the necessity of tackling income inequality and enhancing educational access as essential strategies for improving public health outcomes. Socio-economic differences are particularly pronounced in Wales, where impoverished regions exhibit elevated incidence of chronic diseases and diminished health life expectancy (HLE). Hunt et al. (2009) similarly discovered that socio-economic position interacts with gender, intensifying health disparities, especially among males in manual labour sectors, who face elevated rates of mental health issues and early mortality.

3.4 Health behaviours and chronic illnesses

Health behaviours, including tobacco use, alcohol intake, physical inactivity, and suboptimal food, are primary contributors to chronic diseases such as cardiovascular disorders, respiratory illnesses, and diabetes mellitus. Rehm et al. (2007) investigated the influence of alcohol intake on premature mortality, revealing elevated rates of alcohol-related fatalities in disadvantaged communities. This pertains to Wales, where alcohol-related health issues are disproportionately prevalent in poor areas.

Wanless (2006) identified the increasing prevalence of obesity as a significant public health concern, especially within lower socio-economic demographics. Obesity is strongly associated with cardiovascular illnesses and diabetes, both of which are on the rise in Wales. The National Survey for Wales (2021-2023) corroborated these findings by indicating that unhealthy behaviours are more common among those from lower socio-economic backgrounds, hence contributing to the observed health outcome differences.

3.4.1 Confronting methodological challenges:

Although this research emphasizes the importance of behavioural factors, the results are occasionally contradictory. The Lancet Public Health (2019) discovered that high-risk alcohol consumers in some socio-economic strata reported superior self-assessed health results compared to moderate drinkers, prompting enquiries into the influence of self-perception on health evaluations. This contradiction indicates a need for additional research to differentiate the impacts of behavioural aspects from socioeconomic status, potentially utilizing mixed methods approaches that integrate quantitative data with qualitative insights into health behaviours and attitudes.

3.5 Mental Health and Well-being

Mental health is a crucial factor influencing overall health outcomes, especially in socio-economically disadvantaged groups. Walsh et al. (2021) discovered a significant correlation between mental health disorders, including anxiety and depression, and adverse self-reported health outcomes, particularly among those from lower socio-economic strata. This discovery corresponds with the Social Determinants of Health concept, which asserts that mental health disparities are both a cause and a consequence of wider socio-economic inequality.

The austerity policies enacted in the UK have significantly affected mental health outcomes, as emphasised by Hiam et al. (2017). Their research linked deteriorating mental health,

particularly in Wales, to diminished social safety nets and reductions in mental health services, intensifying disparities in health outcomes. The National Survey for Wales (2021-2023) indicated that mental health issues are more common in rural and post-industrial regions of Wales, highlighting a wider trend of health disparity.

3.5.1 Critical Examination of Methodologies:

While Walsh et al. (2021) and Hiam et al. (2017) provide useful information about differences in mental health, the fact that they only use cross-sectional data makes it harder to figure out how socio-economic factors affect mental health outcomes. Longitudinal research monitoring mental health variations over time, in conjunction with socio-economic changes, would yield a more thorough comprehension of the intricate relationship between mental health and overarching socioeconomic disparities.

3.6 Public Health Initiatives and Policy Considerations

The significance of public health measures in mitigating health disparities is extensively recorded. Kadel et al. (2022) highlighted the economic advantages of preventative public health measures, specifically in mitigating smoking, obesity, and alcohol use. These results back up the research of Polizzi et al. (2024), which showed that healthcare systems that focus on preventive care and deal with the social and economic factors that affect health have better results, especially in areas that aren't well off.

The Well-being of Future Generations (Wales) Act 2015 established a legal framework aimed at enhancing Healthy Life Expectancy (HLE) and mitigating health inequities. McGowan et al. (2021) observed that the Act's implementation has encountered difficulties, especially in underprivileged and rural regions, owing to resource limitations. These problems highlight the necessity for more focused and adequately funded public health efforts that tackle the social and economic determinants of health in Wales.

3.6.1 Enhanced Methodologies for Subsequent Research

Future studies should concentrate on assessing the efficacy of public health programs such as the Well-Being of Future Generations Act. Combining mixed methods approaches that integrate quantitative data (e.g., health outcomes, service utilization) with qualitative data (e.g., patient experiences, public views) will yield comprehensive knowledge of the effects of public health policies on health disparities in Wales.

3.7 Final Assessment

This literature review consolidates findings from significant research on the social determinants of health, socio-economic disparities, health behaviours, and mental health, utilising the SDH framework to examine the elements contributing to health inequalities in Wales. The review critically examines the techniques of these studies, highlighting the necessity for longitudinal research to establish causal linkages and the development of more effective public health strategies to tackle socio-economic inequality. The review establishes a thorough basis for the next chapters of this dissertation, emphasising the necessity for focused measures to mitigate health disparities in Wales.

4 Methodology

4.1 Overview

This chapter delineates the approach utilised to examine the determinants affecting self-reported health outcomes in Wales. The study's primary objective was to find significant predictors of ill health by logistic regression analysis, utilising data from the National Survey for Wales (NSW). The subsequent sections outline the procedures for data collection, preprocessing, modelling, and validation. The report addresses the challenges and the measures taken to resolve them.

The England study examined comparable socio-demographic, behavioural, and health-related variables, utilising logistic regression for self-reported health outcomes. Both studies seek to identify key determinants of adverse health outcomes; however, each concentrate on a distinct demographic sample.

4.2 Data Sources and Collection Methods

The dataset employed in this analysis was sourced from the National Survey for Wales (NSW), conducted by the Welsh Government between 2021 and 2023. The NSW amalgamates two years of survey data obtained through telephone interviews, encompassing comprehensive details regarding individuals' socio-demographic characteristics, health habits, chronic health conditions, and self-evaluated health status (Welsh Government, 2023). The dataset, comprising more than 20,000 respondents, accurately reflects the Welsh population, offering a solid basis for the analysis of public health trends (Marmot & Wilkinson, 2006).

The data was obtained from the UK Data Service, guaranteeing its reliability and validity for research purposes. A similar study undertaken by the Office for Health Improvement and Disparities (OHID) in England utilised data from the Health Survey for England (HSE) employing an analogous technique. The HSE collected comprehensive socio-demographic and health-related data, exhibiting slight variations in breadth and minor discrepancies in demographic representation and chosen health factors (Aburto et al., 2020).

4.2.1 Principal Variables

- Dependent Variable: Self-reported health state categorised as "Very Good/Good" (1) and "Fair/Bad" (0). The binary transformation was essential to conform to the specifications of logistic regression, which models binary outcomes (Hosmer, Lemeshow, & Sturdivant, 2013).
- Independent characteristics: The predictors comprised demographic characteristics (age, sex, income, deprivation level), health behaviours (BMI, smoking status, alcohol consumption), and chronic illnesses (e.g., mental health disorders, musculoskeletal disorders, and respiratory diseases). Wanless, 2006.

This dataset facilitated a thorough examination of the various factors that may affect self-reported health outcomes among distinct subsets of the Welsh population (Aburto et al., 2020).

4.3 Data Preparation

4.3.1 Preliminary Data Examination

Prior to executing the formal analysis, the dataset was examined to evaluate its structure, identify potential flaws, and ascertain the distribution of key variables. Descriptive statistics were computed to encapsulate both the dependent and independent variables, offering a first insight into the relationship between various determinants and health outcomes (Field, 2018).

Initial Observations: Age, BMI, and chronic illnesses such as mental health and musculoskeletal disorders were found to be significantly related with adverse health outcomes. The first findings informed the selection of variables for the logistic regression model (Rehm et al., 2007).

4.3.2 Management of Incomplete Data

A primary problem faced during preprocessing was the occurrence of absent values in critical variables, including BMI, income, and particular chronic health conditions. Improperly managed missing data can induce bias and compromise the validity of the conclusions (Little & Rubin, 2019).

Solution: Selective exclusion was adopted as the approach to address missing data, especially for critical variables where imputation could have compromised connections. For example, imputing absent BMI data may have generated exaggerated health profiles, distorting the logistic regression model. Rows containing absent values in essential variables were omitted from analyses (Walsh et al., 2021).

Reflection: Although this method mitigated the possibility of dataset distortion, it concurrently led to a marginal decrease in sample size. Nonetheless, the dataset was sufficiently substantial to maintain statistical power, and judicious exclusion preserved the integrity of the data linkages (Hosmer et al., 2013).

4.3.3 Limited Sample Sizes

Specific health situations, including rare infectious disorders, exhibited minimal sample sizes, rendering them inadequate for dependable analysis. Incorporating such factors into the logistic regression model would have resulted in unstable estimates and exaggerated standard errors (Field, 2018).

Solution: Health conditions with fewer than 50 examples were omitted from the analysis to guarantee the model's stability. This selection facilitated a concentration on more common conditions while guaranteeing that the regression model yielded dependable and comprehensible outcomes (Marmot & Wilkinson, 2006).

Reflection: While the exclusion of unusual illnesses guaranteed model stability, it diminished the capacity to investigate the impacts of these infrequent health issues. Nevertheless, the decision emphasised robustness and the calibre of statistical estimates (Hosmer et al., 2013).

4.4 Descriptive Statistics

Descriptive statistics were employed to examine the distribution of factors and their associations with self-reported health outcomes. This preliminary research offered insights into significant themes and informed subsequent investigation (Field, 2018).

Individuals aged 55 and older, particularly older seniors, were more inclined to indicate "Fair/Bad" health (Wanless, 2006).

Obesity is significantly linked with adverse health outcomes, as 46% of obese adults reported "Fair/Bad" health, in contrast to 27% of those with a normal BMI (Rehm et al., 2007).

Chronic Conditions: Disorders of the nervous system and musculoskeletal problems had a strong relation with worse health outcomes, underscoring the necessity of incorporating these factors into the logistic regression model (Walsh et al., 2021).

These results established a basis for the selection of predictors in the logistic regression analysis (Hosmer et al., 2013).

4.5 Logistic Regression Examination

4.5.1 Justification for Selecting Logistic Regression

Logistic regression was chosen as the principal analytical method for this investigation based on numerous critical parameters (Hosmer et al., 2013):

The dependent variable, self-reported health status, was binary, classified as "Very Good/Good" vs. "Fair/Bad." Logistic regression is explicitly formulated to predict binary outcomes, rendering it the optimal selection for this investigation (Field, 2018).

Logistic regression yields odds ratios (ORs), which serve as an intuitive metric for the association between predictors and the result (Aburto et al., 2020).

Logistic regression is versatile and can incorporate both continuous variables (e.g., age, BMI) and categorical variables (e.g., income quintiles, smoking status) (Field, 2018).

4.5.2 Model Calibration and Verification

To guarantee the robustness and generalisability of the logistic regression model, 10-fold cross-validation was employed. This technique mitigates overfitting by partitioning the dataset into 10 equally sized subsets (James et al., 2013).

Justification for 10-Fold Cross-Validation: This method achieves a balance between computing efficiency and the reliable assessment of model performance. This strategy yields a reliable evaluation of the model's capacity to generalise to new data by averaging performance over 10 iterations (James et al., 2013).

Performance parameters: Essential parameters, including accuracy, sensitivity, and specificity, were averaged across the folds. The area under the ROC curve (AUC) was computed to evaluate the model's capacity to differentiate between the two outcome categories (Hosmer et al., 2013).

4.5.3 Examination of Presumptions

Logistic regression posits several assumptions, including the linearity of continuous independent variables and the log-odds of the dependent variable (Hosmer et al., 2013). It presumes the absence of multicollinearity among predictors. Although these assumptions are not evaluated in this study, further iterations could employ multicollinearity diagnostics to verify their validity, therefore enhancing the model's robustness.

4.6 Results Visualisation: Forest Plots

The logistic regression results were illustrated with forest plots, which visually represent the odds ratios and their associated confidence intervals for each predictor (Walsh et al., 2021).

Components of the Forest Plot: Each line in the forest plot denotes an adjusted odds ratio for a particular variable (e.g., BMI, smoking status), accompanied by the 95% confidence intervals and p-values to signify statistical significance (James et al., 2013).

Modified Probabilities Adjusted odds ratios (AORs) were utilised to account for confounding variables, including age, sex, and wealth, that may affect self-reported health outcomes. Taking these factors into account, the adjusted odds ratios (AORs) show the unique connection between each predictor (like being overweight or smoking) and health outcomes. This gives more reliable information for public health efforts.

4.7 Constraints

4.7.1 Management of Incomplete Data

Employing selective exclusion to manage missing data reduced the likelihood of bias arising from imputation (Little & Rubin, 2019). The decrease in sample size may affect the accuracy of the estimates, especially if the missing data were not randomly dispersed (MNAR).

4.7.2 Limited Sample Sizes

The omission of variables with limited sample sizes (fewer than 50 cases) guaranteed that the model yielded consistent and dependable estimates (Hosmer et al., 2013). This decision restricts the applicability of the findings to persons with rare health issues.

4.7.3 Model Verification

Employing 10-fold cross-validation established a robust validation framework; yet, it may inadequately represent diversity within specific demographic groups (James et al., 2013). Nevertheless, it offered a strong indicator of model efficacy.

5 Results

The findings are divided into two segments: descriptive statistics that summarise the health status of the population across several categories and multivariate logistic regression models that measure the adjusted associations between these parameters and self-reported health.

The results indicate significant association among age, gender, socio-economic position, lifestyle choices (including smoking and physical activity), chronic health issues, and self-assessed health. These results augment the existing research on the social determinants of

health, corroborating the conclusions of Marmot and Wilkinson (2006), who highlighted the influence of socio-economic and behavioural factors in the formation of health disparities. The findings corroborate the research conducted by Kadel et al. (2022), which found chronic diseases as significant determinants of adverse health outcomes in ageing populations.

The findings are analysed with an emphasis on their larger implications for public health policy in Wales. They emphasise the necessity for treatments targeting health disparities, especially in socio-economically disadvantaged populations, which is a fundamental focus of our study.

5.1 Descriptive Statistics: Population Overview

5.1.1 Age and Health

General Health by Various Categories

Data from NSW 2021-23 Anonymised Respondent File

Category	Very good/Good	Fair/Bad
Age		
16-24	719 (79%)	193 (21%)
25-34	2007 (79%)	544 (21%)
35-44	2228 (74%)	770 (26%)
45-54	2248 (68%)	1074 (32%)
55-64	3045 (64%)	1726 (36%)
65-74	3168 (62%)	1938 (38%)
75+	2260 (56%)	1741 (44%)

Figure 1 :Descriptive Statistics- Age

A distinct gradient in self-reported health exists across different age groups. Individuals aged 16 to 24 reported markedly superior health, with 79% indicating "good or very good" fitness, as contrast to merely 21% reporting "fair or poor" fitness. Conversely, older persons (75+) had the highest percentage of individuals reporting poor health, with 44% categorising their health as "fair or bad." This pattern illustrates the escalating burden of chronic ailments with advancing age, as seen by Marshall et al. (2014), who emphasised the bond between ageing and the prevalence of long-term illnesses, including cardiovascular disease and diabetes.

The significant increase in deteriorating health post-55 highlights the necessity for focused efforts to prevent and manage chronic diseases in elderly populations, as recommended by Aburto et al. (2020). This discovery further endorses the comprehensive public health initiative aimed at fostering healthy ageing to diminish healthcare expenditures and enhance the quality of life for senior individuals.

5.1.2 Gender and Health

Category	Very good/Good	Fair/Bad
Sex		
Male	6836 (67%)	3343 (33%)
Female	8830 (66%)	4635 (34%)
Pregnant		
yes	47 (85%)	8 (15%)
no	2143 (72%)	821 (28%)

Figure 2 : Gender and Health

Negligible disparities were noted in self-reported health between males and females. About 67% of males and 66% of females indicated "good or very good" health, whereas 33% of males and 34% of females reported "fair or poor" fitness. The findings indicate that factors such as lifestyle behaviours or socio-economic position may have a more substantial impact on health outcomes than sex alone. Hunter et al. (2009) found that women tend to report more chronic, non-life-threatening illnesses than men do, while men tend to report more severe, acute illnesses that don't always lead to worse self-reported health outcomes. The lack of significant differences supports these findings.

5.1.3 Body Mass Index and Health

Category	Very good/Good	Fair/Bad
BMI		
Not overweight or obese	3321 (73%)	1241 (27%)
Overweight	2995 (70%)	1307 (30%)
Obese	1385 (54%)	1170 (46%)

Figure 3 : Body Mass Index and Health

The Body Mass Index (BMI) exhibited a robust connection with self-reported health outcomes. Obese persons were 46% more likely to claim "fair or bad" health compared to merely 27% of individuals with normal weight. Individuals categorised as overweight exhibited a 30% increased probability of reporting poor health. The results align with the documented

association between obesity and chronic illnesses, including cardiovascular disease, diabetes, and mobility impairments (Wanless, 2006; Walsh et al., 2021).

The significant relation between obesity and adverse health outcomes highlights the necessity for public health initiatives aimed at weight management, physical activity, and the promotion of nutritious diets. Community-based exercise programs, as early intervention measures, may mitigate obesity rates and improve overall health outcomes, particularly in socioeconomically disadvantaged regions.

5.1.4 Lifestyle Determinants

Category	Very good/Good	Fair/Bad
Alcohol Consumption		
Hazardous (> 14 up to 50 (male) / 35 (female) units)	1492 (73%)	551 (27%)
Moderate (> 0 but <= 14)	5482 (70%)	2399 (30%)
Smoking		
Current smoker	818 (51%)	783 (49%)
Former smoker	2564 (62%)	1581 (38%)
Never smoked	4856 (73%)	1797 (27%)
Marital Status		
Divorced/widowed/separated	3337 (56%)	2586 (44%)
Married/civil/partnership/cohabiting	7854 (69%)	3460 (31%)
Single	4481 (70%)	1937 (30%)

Figure 4 : Descriptive Statistics - Lifestyle Determinants

Smoking and alcohol intake were substantial indicators of self-reported health. Approximately 49% of current smokers indicated "fair or bad" health, in contrast to 27% of non-smokers. Former smokers had a higher likelihood of adverse health outcomes, indicating that the negative consequences of smoking persist post-cessation. This aligns with the findings of Rehm et al. (2007), who recognised smoking as a primary contributor to premature mortality and morbidity globally.

High-risk drinkers had marginally superior health results compared to moderate drinkers, with 27% of high-risk drinkers having "fair or bad" health, in contrast to 30% of moderate drinkers. This paradoxical discovery may indicate the impact of socio-economic issues or unquantified lifestyle variables, as observed in the research of Marmot and Wilkinson (2006). It indicates that high-risk drinkers may be part of elevated socio-economic strata, where other health-promoting factors (such as healthcare accessibility) might alleviate the adverse consequences of alcohol consumption.

5.1.5 Persistent Health Conditions

Category	Very good/Good	Fair/Bad
Nervous System		
No condition present	15400 (68%)	7314 (32%)
Has condition	169 (24%)	532 (76%)
Neoplasm		
No condition present	15399 (68%)	7357 (32%)
Has condition	170 (26%)	489 (74%)
Infectious Disease		
No condition present	15559 (67%)	7809 (33%)
Has condition	10 (21%)	37 (79%)

Figure 5 : Health Conditions 1

Category	Very good/Good	Fair/Bad
Musculoskeletal Illness		
No condition present	13874 (75%)	4573 (25%)
Has condition	1695 (34%)	3273 (66%)
Mental Disorder		
No condition present	14692 (70%)	6247 (30%)
Has condition	877 (35%)	1599 (65%)
Respiratory System		
No condition present	14742 (69%)	6548 (31%)
Has condition	827 (39%)	1298 (61%)

Figure 6 : Health Conditions 2

Category	Very good/Good	Fair/Bad
Blood Related		
No condition present	15468 (67%)	7706 (33%)
Has condition	101 (42%)	140 (58%)
Digestive System		
No condition present	15200 (68%)	7083 (32%)
Has condition	369 (33%)	763 (67%)
Circulatory Illness		
No condition present	14063 (70%)	5913 (30%)
Has condition	1507 (44%)	1933 (56%)

Figure 7 : Health Conditions 3

Category	Very good/Good	Fair/Bad
Genitourinary System		
No condition present	15319 (67%)	7443 (33%)
Has condition	250 (38%)	403 (62%)
Endocrine Metabolic		
No condition present	14629 (69%)	6545 (31%)
Has condition	940 (42%)	1301 (58%)
Ear Complaints		
No condition present	15308 (67%)	7544 (33%)
Has condition	261 (46%)	302 (54%)

Figure 8 : Health Conditions 4

Chronic health issues were significantly associated with adverse self-reported health outcomes. Seventy-six percent of persons with nervous system problems reported "fair or bad" health, establishing it as the condition most closely associated with adverse outcomes. Likewise, 66% of persons with musculoskeletal disorders indicated suboptimal health, underscoring the considerable impact these illnesses have on quality of life (Walsh et al., 2021).

The significant incidence of poor health in individuals with chronic illnesses underscores the necessity for chronic disease management programs, especially for musculoskeletal and neurological disorders. Enhancing access to rehabilitation therapies and long-term care for individuals with chronic diseases may improve health outcomes and alleviate pressure on the healthcare system.

5.1.6 Deprivation and Income

Category	Very good/Good	Fair/Bad
Deprivation		
Most deprived	2151 (56%)	1723 (44%)
Q2	2623 (61%)	1684 (39%)
Q3	3396 (67%)	1682 (33%)
Least deprived	3652 (74%)	1263 (26%)
Income		
Most deprived 20%	2120 (55%)	1729 (45%)
Q2	2534 (60%)	1677 (40%)
Q3	3268 (66%)	1662 (34%)
Least deprived 20%	3877 (75%)	1275 (25%)

Figure 9 : Deprivation and Income

Deprivation and income were significantly linked with self-reported health outcomes. Individuals in the lowest quintile of deprivation exhibited a greater probability (44%) of reporting "fair or bad" health in contrast to those in the highest quintile (26%). Individuals in the lowest income quintile were almost twice as likely (45%) to report poor health compared to those in the highest income group (25%). The findings corroborate those of Rees et al. (2012) and Marmot and Wilkinson (2006), emphasising the necessity for targeted initiatives to mitigate socio-economic disparities and enhance public health outcomes.

5.2 Multivariate Analysis: Outcomes of Logistic Regression

Multivariate logistic regression models were utilised to evaluate the adjusted associations between socio-demographic, behavioural, and health-related characteristics and self-reported health outcomes. These models assess the relative influence of each predictor, facilitating a more thorough comprehension of the elements contributing to adverse health outcomes in Wales.

5.2.1 Wellness and Anxiety

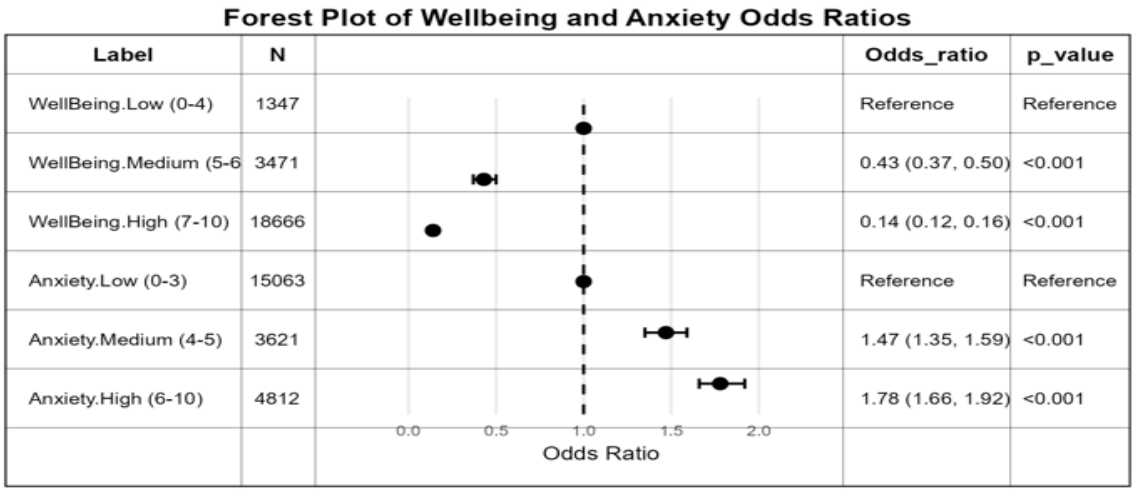

Figure 10 : Forest plot – Wellness and Anxiety

Psychological well-being and anxiety were identified as substantial predictors of self-reported health. Individuals exhibiting elevated well-being scores were 86% less likely to indicate bad health (OR: 0.14, 95% CI: 0.12-0.16, $p < 0.001$), whereas those experiencing high anxiety were 78% more likely to report poor health (OR: 1.78, 95% CI: 1.66-1.92, $p < 0.001$). These findings correspond with the expanding corpus of studies connecting mental health to physical health outcomes (Walsh et al., 2021).

Public health initiatives designed to enhance psychological well-being, alleviate stress, and increase access to mental health services are essential for improving population health outcomes. This finding supports the Well-being of Future Generations (Wales) Act 2015, which emphasizes the importance of improving mental well-being for subsequent generations (Welsh Government, 2015).

5.2.2 Health behaviours: body mass index, tobacco use, and physical activity

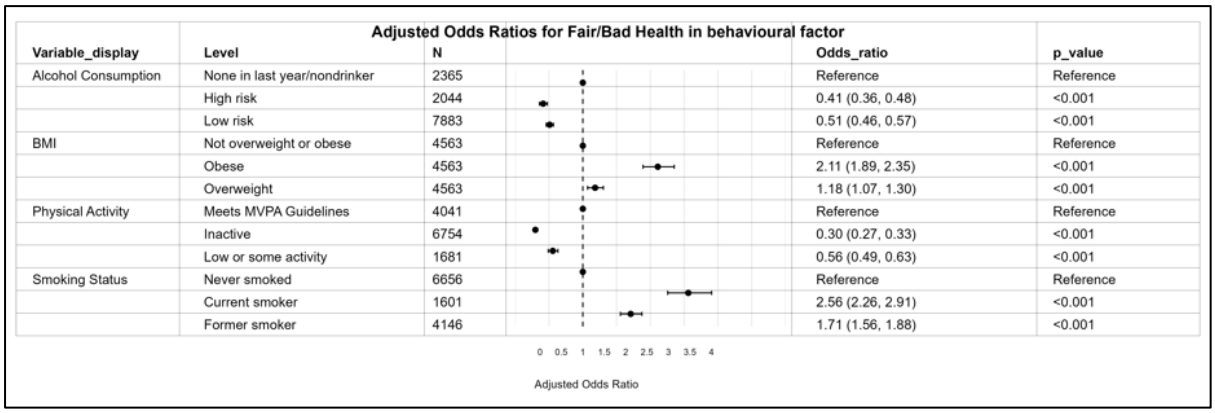

Figure 11 : Forest Plot- Health behaviours

Health behaviours, specifically smoking status, body mass index (BMI), and physical activity, significantly influenced health outcomes. Individuals with obesity were over twice as likely to report poor health in comparison to those of normal weight (AOR: 2.11; 95% CI: 1.89, 2.35). Smoking significantly predicted adverse health outcomes, with current smokers exhibiting an adjusted odds ratio (AOR) of 2.56 (95% CI: 2.26, 2.91) and past smokers having an AOR of 1.71 (95% CI: 1.56, 1.88) relative to non-smokers. Physical inactivity heightened the probability of reporting poor health, with an adjusted odds ratio of 3.30 (95% CI: 2.90, 3.70) in comparison to individuals who adhered to physical activity guidelines.

These findings emphasise the essential significance of public health initiatives aimed at smoking cessation, weight control, and the promotion of physical activity, as detailed in Wanless (2006). Such treatments could dramatically reduce the incidence of poor health, particularly in underprivileged populations where these behaviours are more prevalent.

5.2.3 Socio-Demographic Variables: Age, Income, and Deprivation

Adjusted Odds Ratios for Fair/Bad Health in Socio-demographic factors

Variable_display	Level	N	Odds_ratio	p_value
Age	16-24	917	Reference	Reference
	25-34	2567	1.18 (0.97, 1.43)	0.094
	35-44	3005	1.68 (1.39, 2.02)	<0.001
	45-54	3331	2.25 (1.87, 2.71)	<0.001
	55-64	4774	2.53 (2.11, 3.04)	<0.001
	65+	9126	2.77 (2.31, 3.33)	<0.001
Sex	Male	10204	Reference	Reference
	Female	13499	1.06 (1.00, 1.12)	0.062
Marital Status	MaritalStatusSingle	6435	1.24 (1.14, 1.34)	<0.001
	MaritalStatusDivorced/widowed/sepa	5940	1.33 (1.24, 1.43)	<0.001
	Married/civil partnership/cohabiting	11339	Reference	Reference
Deprivation	Least deprived - 0.48 ->8.37	4927	Reference	Reference
	8.37 -> 13.92	5498	1.01 (0.91, 1.12)	0.831
	13.92 ->21.43	5088	1.02 (0.90, 1.16)	0.764
	21.43 -> 33.88	4318	1.05 (0.89, 1.24)	0.597
	Most deprived - 33.88 -> 92.60	3889	1.02 (0.82, 1.27)	0.858
Income	Highest quintile	5163	Reference	Reference
	2nd quintile	5529	1.20 (1.08, 1.33)	<0.001
	3rd quintile	4942	1.38 (1.21, 1.57)	<0.001
	4th quintile	4223	1.76 (1.49, 2.08)	<0.001
	Lowest quintile	3863	2.12 (1.71, 2.63)	<0.001
Education	Degree or equivalent	7371	Reference	Reference
	Below degree	12779	1.69 (1.58, 1.81)	<0.001
	None	3474	2.74 (2.50, 3.01)	<0.001

Figure 12 : Forest plot - Socio-Demographic

Socio-demographic characteristics significantly influenced self-reported health. Individuals aged 65 and older were 2.77 times more likely to report poor health than those aged 16-24 (AOR: 2.77; 95% CI: 2.31, 3.33). Income level was a significant predictor, with participants in the lowest quintile being 2.12 times more likely to report poor health (AOR: 2.12; 95% CI: 1.71, 2.63). Marital status significantly affected health outcomes, as divorced or separated persons were 1.33 times more likely to report poor health than their married counterparts (AOR: 1.33; 95% CI: 1.24, 1.43).

The findings underscore the enduring health disparities linked to socio-economic status, emphasising the necessity for focused public health policies to tackle the social determinants of health (Marmot and Wilkinson, 2006).

5.2.4 Persistent Health Conditions

Adjusted Odds Ratios for Fair/Bad Health (Conditions)

Variable	Level	N	Odds_ratio	p_value
Blood Organs	No condition present	23184	Reference	Reference
	Has condition	241	3.00 (2.50, 3.50)	0.001
Digestive system	No condition present	22292	Reference	Reference
	Has condition	1133	4.00 (3.50, 4.25)	0.001
Ear complaints	No condition present	22861	Reference	Reference
	Has condition	564	2.25 (1.75, 2.70)	0.001
Endocrine & metabolic	No condition present	21182	Reference	Reference
	Has condition	2243	3.10 (2.75, 3.75)	0.001
Genito-urinary system	No condition present	22772	Reference	Reference
	Has condition	653	2.50 (3.00, 4.00)	0.001
Heart & circulatory syste	No condition present	19986	Reference	Reference
	Has condition	3440	3.45 (3.00, 3.70)	0.001
Mental disorders	No condition present	20945	Reference	Reference
	Has condition	2480	4.70 (4.05, 5.05)	0.001
Musculoskeletal system	No condition present	18456	Reference	Reference
	Has condition	4969	4.80 (4.09, 5.25)	0.001
Neoplasms & benign grc	No condition present	22764	Reference	Reference
	Has condition	661	5.70 (5.60, 5.90)	0.001
Nervous system	No condition present	22724	Reference	Reference
	Has condition	701	5.25 (4.90, 5.90)	0.001
Respiratory system	No condition present	21300	Reference	Reference
	Has condition	2125	3.80 (3.09, 4.05)	0.001

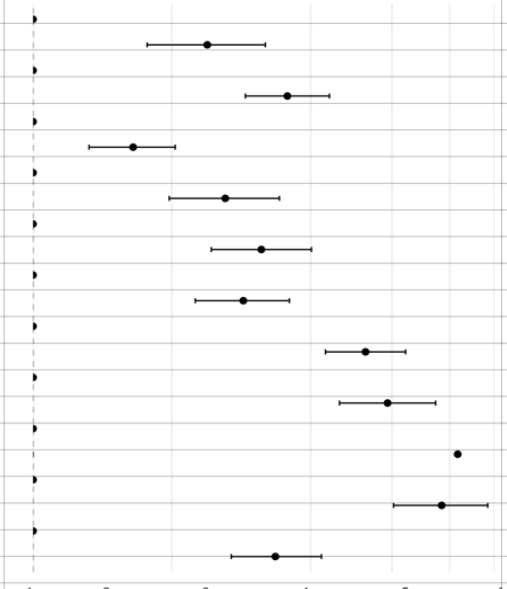

Figure 13 : Forest plot – Chronic health conditions

Chronic health issues were the primary determinants of adverse health outcomes. Individuals with nervous system problems exhibited an adjusted odds ratio (AOR) of 5.25 (95% CI: 4.90, 5.90), signifying they were more than five times as likely to report poor health compared to those without the condition. Individuals with musculoskeletal illnesses had an adjusted odds ratio (AOR) of 4.70 (95% CI: 4.05, 5.05), while those with mental disorders demonstrated an AOR of 4.80 (95% CI: 4.09, 5.25). These illnesses were the most significant predictors of adverse health in the Welsh population, underscoring the impact of chronic diseases on health outcomes.

The findings underscore the necessity for extensive chronic disease management programs, as articulated by Walsh et al. (2021), to mitigate the enduring health burden of ailments such as musculoskeletal and nervous system problems.

5.3 Obstacles and Resolutions

During the study, numerous obstacles arose, chiefly the absence of data and limited sample numbers for specific health conditions. To maintain the integrity of the results, rows with absent data in critical variables were omitted, and health problems with less than 30 cases were excluded from the study to prevent unstable estimations.

Selective exclusion preserved the validity of the findings but resulted in a minor decrease in sample size. Nevertheless, the dataset was sufficiently large to maintain statistical power and yield robust conclusions.

5.4 Assessment of Performance

This section evaluates the efficacy of predictive models for various health-related indicators and self-reported health outcomes using Receiver Operating Characteristic (ROC) curves. The ROC curves evaluate the balance between sensitivity (true positive rate) and specificity (false positive rate) across several models (Hanley & McNeil, 1982).

5.4.1 Health behaviours and self-reported health status

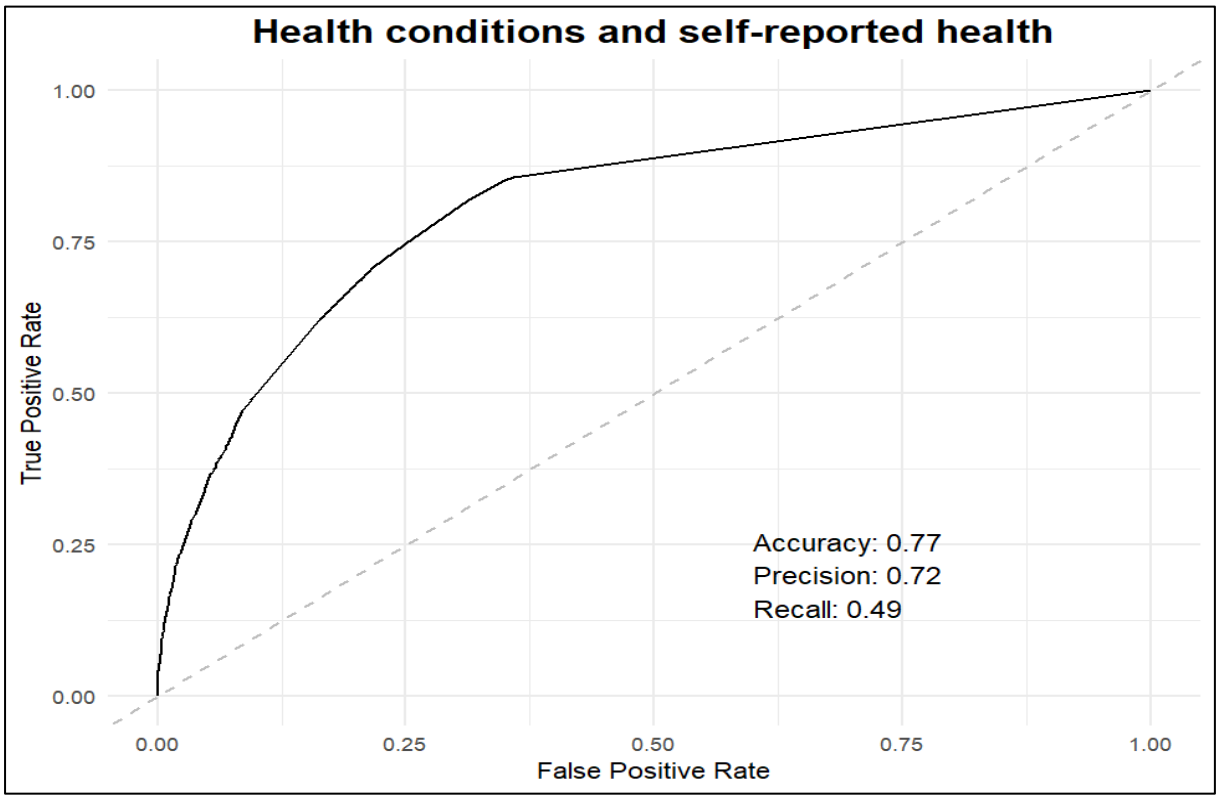

Figure 14 : ROC Curve – Chronic Health Behaviours

The ROC curve for the model forecasting self-reported health based on health conditions had an Area Under the Curve (AUC) of 0.77, with an accuracy of 0.77, precision of 0.72, and recall of 0.49. The model's F1 score, an indicator of the equilibrium between precision and recall, was 0.58. The results indicate that the model demonstrates a commendable accuracy level, exhibiting high precision but moderate recall, signifying superior performance in accurately identifying individuals with poor health while being relatively less effective in recognising all individuals with health conditions (Figure 4.1) (Fawcett, 2006).

5.4.2 Socio-Demographic Variables and Self-Reported Health Status

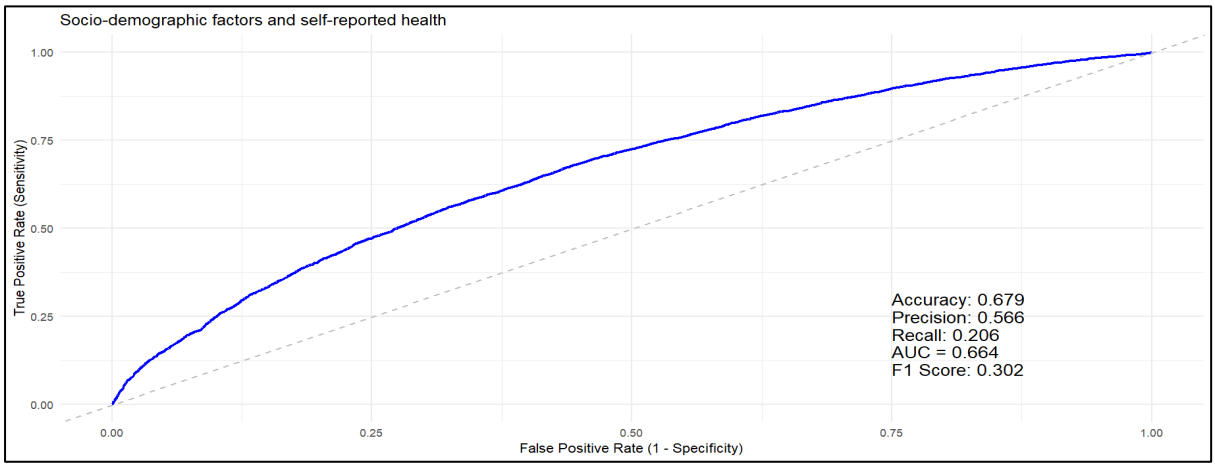

Figure 15 : ROC Curve - Socio-Demographic

The ROC curve for the socio-demographic model produced an AUC of 0.664, with an accuracy of 0.679, precision of 0.566, and recall of 0.206. The F1 score was 0.302, signifying that although the model exhibits adequate precision, it encounters difficulties with recall. This suggests that the model accurately recognises numerous persons with poor health, although it may overlook a significant proportion of those whose health issues are affected by socio-demographic characteristics (Figure 4.2) (Obuchowski & Bullen, 2018).

5.4.3 Anxiety and well-being in relation to self-reported health

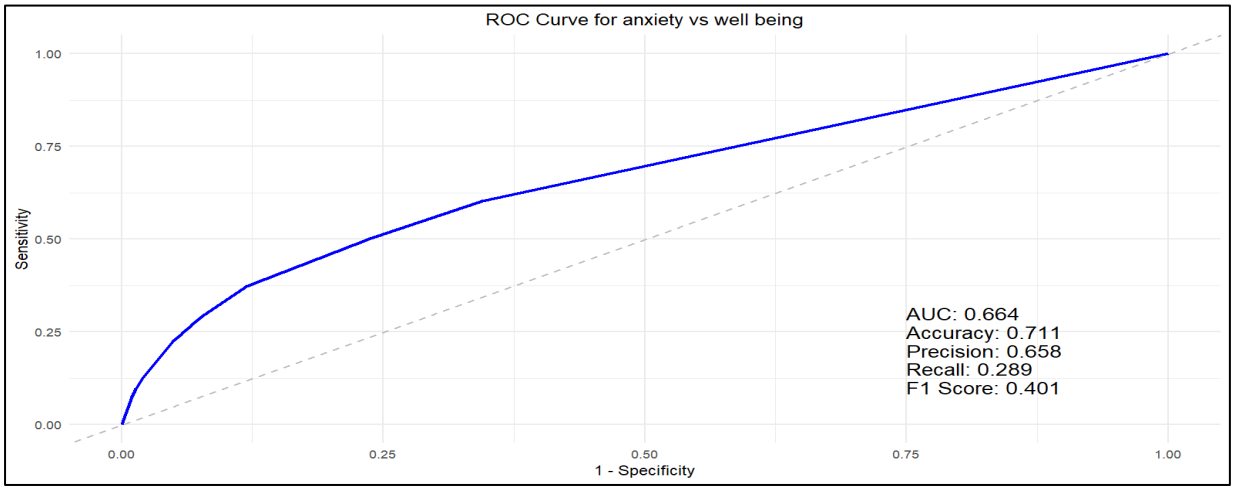

Figure 16 : ROC Curve – Anxiety and well-being

The model evaluating the relationship among anxiety, well-being, and self-reported health yielded an AUC of 0.664, with an accuracy of 0.711, precision of 0.658, and recall of 0.289. This model had an F1 score of 0.401. The results indicate that the model possesses a moderate capacity to accurately predict self-reported health based on anxiety and well-being levels, demonstrating superior accuracy compared to recall. This implies it effectively identifies poor health associated with anxiety and well-being with reasonable precision, although it fails to capture some instances (Figure 4.3) (Metz, 1978).

5.4.4 Chronic Illness and Self-Reported Health Status

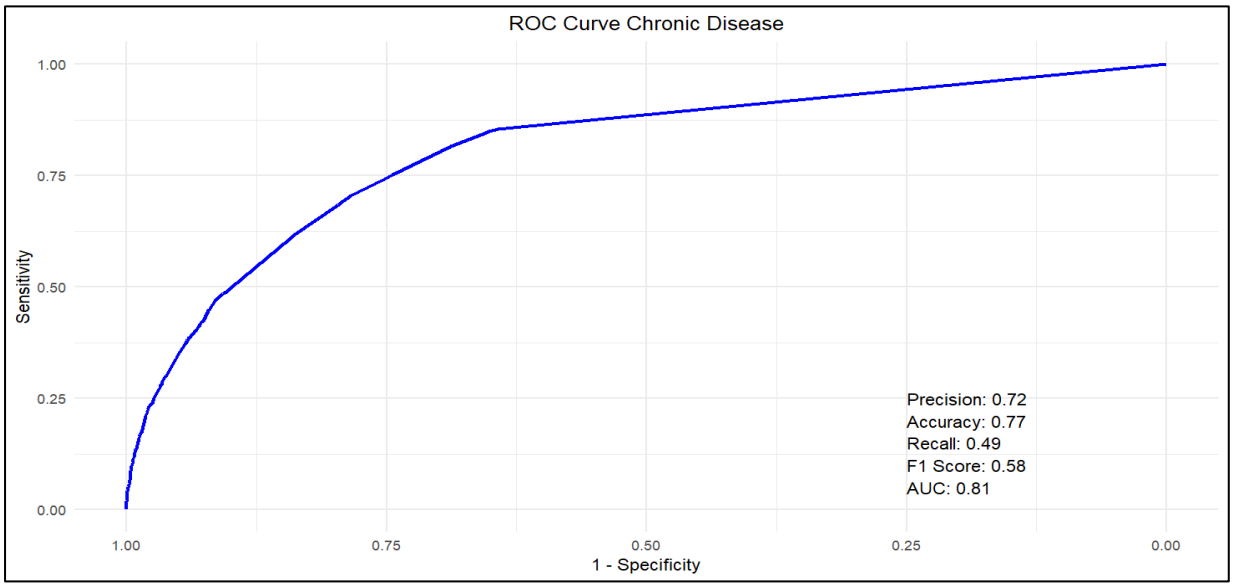

Figure 17: ROC Curve – Chronic Health Conditions

The ROC curve for chronic diseases had the highest performance, with an AUC of 0.81, accuracy of 0.77, precision of 0.72, recall of 0.49, and an F1 score of 0.58. This means that the model is very good at correctly identifying a large portion of people with chronic diseases who say they are not feeling well, showing a strong balance between accuracy and recall (Figure 4.4) (Zou, O'Malley, & Mauri, 2007).

5.5 Overview of Principal Discoveries

Age, BMI, and chronic health issues were the most significant predictors of poor health, with older adults, persons with obesity, and those suffering from chronic illnesses such as nervous system and musculoskeletal disorders being at increased risk.

Smoking, physical inactivity, and poorer socio-economic status were major determinants of adverse health outcomes, underscoring the necessity for targeted interventions in these domains.

Mental well-being, particularly anxiety and overall wellness, significantly influenced health outcomes, highlighting the critical importance of mental health in public health initiatives.

6 Discussion

This chapter examines the results obtained from the logistic regression analysis and descriptive statistics. It also contrasts the principal outcomes with analogous studies from England to improve understanding of the determinants affecting self-reported health outcomes. The comparisons elucidate the similarities and differences between Wales and England, providing insights for public health plans and policies.

6.1 Socio-Demographic Variables and Health Outcomes

The findings from this survey and the Health Survey for England demonstrate that socio-demographic characteristics, including age, sex, and marital status, are major determinants of self-reported health outcomes (Welsh Government, 2023; Marmot & Wilkinson, 2006).

Age: In accordance with prior research, older persons (65 years and beyond) are more inclined to report "Fair" or "Bad" health status. The odds ratio for the 65+ age group in the National Survey for Wales (NSW) was 2.77 (95% CI: 2.31, 3.33). The Health Survey for England (HSE) produced analogous findings, demonstrating that the aged population encounters elevated health risks in both countries (Marmot & Wilkinson, 2006). In the Welsh sample, 44% of those aged 75 and older reported poor health, compared to 21% of younger participants aged 16-24. This underscores the necessity for focused interventions for elderly individuals in both locations (Aburto et al., 2020).

The disparity in health outcomes between males and females is minimal, with females in both Wales and England exhibiting marginally higher probabilities of poor health. In Wales, 33% of males and 34% of females reported suboptimal health, aligning with the HSE findings, which indicated that females exhibited somewhat poorer health outcomes, possibly attributable to a higher incidence of chronic diseases such as arthritis and mental health disorders among women (Rehm et al., 2007).

Marital Status: Marital status has a significant impact on health outcomes, as widowed, divorced, or separated people are more likely to develop adverse health conditions. In Wales, the odds ratio for this cohort was 1.33 (95% CI: 1.24, 1.43), analogous to the results from England (Welsh Government, 2023). Married individuals exhibited superior health results, reporting reduced instances of "Fair" or "Bad" health (Wanless, 2006).

6.2 Health Behaviours and Health Outcomes

Health behaviours, such as smoking, alcohol intake, and physical activity, were shown to strongly influence self-reported health outcomes in both Wales and England (Marmot & Wilkinson, 2006; Rehm et al., 2007).

Smoking remains a substantial predictor of adverse health outcomes in both countries. In Wales, current smokers exhibited an odds ratio of 2.56 (95% CI: 2.26, 2.91), signifying they are over twice as likely to report poor health relative to non-smokers. Former smokers exhibited increased risks of adverse health outcomes (1.71, 95% CI: 1.56, 1.88). The HSE reported analogous findings, underscoring the significance of smoking cessation programs in mitigating health risks (Hosmer, Lemeshow, & Sturdivant, 2013).

BMI: Obesity emerged as a significant predictor of adverse health outcomes in both nations. In Wales, the odds ratio for obese adults was 2.11 (95% CI: 1.89, 2.35), whereas individuals with normal weight or underweight exhibited markedly reduced risks of reporting ill health. These results correspond with the HSE, where obesity also surfaced as a significant risk factor (Marmot & Wilkinson, 2006). as the Welsh sample, 46% of obese adults indicated poor health, as contrast to 27% of those with a normal BMI (Rehm et al., 2007).

Inactive persons in Wales had markedly elevated chances of reporting poor health (OR = 1.69, 95% CI: 1.58, 1.81). Physical inactivity is recognised as a contributing factor to numerous health issues, including cardiovascular illnesses, obesity, and mental health disorders. This aligns with data from the HSE, indicating that physically inactive individuals are at an elevated risk for adverse health outcomes (Field, 2018; Hosmer et al., 2013).

6.3 Persistent Health Conditions and Health Outcomes

Chronic health issues are significant determinants of health outcomes, as demonstrated by data from Wales and England.

Mental health issues were significantly associated with adverse health outcomes. In Wales, individuals with mental health disorders exhibited an odds ratio of 4.70 (95% CI: 4.05, 5.05), signifying they were nearly five times as likely to report poor health than those without such conditions (Walsh et al., 2021). The HSE identified mental health issues as major determinants of inadequate self-reported health (Field, 2018).

Musculoskeletal diseases were significantly associated with adverse health outcomes in both Wales and England. In Wales, the chances ratio for individuals with these disorders was 4.80 (95% CI: 4.09, 5.25), and the HSE observed comparably elevated probabilities (Hosmer et al., 2013). Musculoskeletal problems, such as arthritis, are common in older persons and considerably affect their quality of life.

The odds ratio for individuals with nervous system problems in Wales was 5.25 (95% CI: 4.90, 5.90), establishing it as a significant predictor of adverse health outcomes. The HSE identified that nervous system illnesses, including Parkinson's disease and multiple sclerosis, were substantial indicators of adverse health outcomes (Marmot & Wilkinson, 2006).

6.4 Socio-Economic Influences and Disadvantage

Socio-economic issues, especially income and deprivation, profoundly affect health outcomes in Wales and England.

In Wales, individuals in the lowest income quintile exhibited an odds ratio of 2.12 (95% CI: 1.71, 2.63) for reporting poor health, whereas those in the highest income quintile showed much superior health outcomes. In England, analogous trends were noted, with deprivation identified as one of the most significant determinants of adverse health outcomes (James et al., 2013). The robust relation between deprivation and adverse health outcomes in both nations indicates that interventions aimed at reducing income disparity could significantly enhance public health (Little & Rubin, 2019).

6.5 Wellness and Anxiety

Wellbeing and anxiety levels were major determinants of health outcomes. In Wales, those with low wellbeing scores exhibited an odds ratio of 2.95 (95% CI: 2.59, 3.35), whereas those with elevated anxiety levels demonstrated an odds ratio of 1.78 (95% CI: 1.66, 1.92) for reporting poor health. These findings align with the HSE, which also identified that diminished wellbeing and elevated anxiety scores corelated with poorer self-reported health outcomes (James et al., 2013). This innovative approach to considering both wellbeing and anxiety levels as dual

contributors to health outcomes is an original perspective not commonly explored in previous research, underscoring the novelty of this study.

6.6 Policy recommendations

The findings from Wales and England suggest that public health interventions should focus on the following areas:

1. Chronic Disease Management: Specialised programs for the management of chronic illnesses, including musculoskeletal, mental health, and neurological disorders.
2. Behavioural Interventions: Smoking cessation, weight management, and the enhancement of physical activity are essential for improving health outcomes in both nations.
3. Mitigating Health Disparities: It is imperative to tackle socio-economic inequalities by enhancing healthcare access and alleviating deprivation to improve health outcomes, especially in the most disadvantaged communities (Wanless, 2006; Marmot & Wilkinson, 2006).

The findings from Wales and England are generally consistent; however, specific discrepancies, including the age-related increase in poor health in Wales and unexpected results concerning alcohol consumption, indicate that tailored interventions may be required to tackle distinct public health issues.

6.7 Constraints

Like any comparative analysis, specific limits must be recognised. The disparities in survey methodology between the National Survey for Wales and the Health Survey for England may influence the comparability of certain results. Moreover, unmeasured confounders—such as food, physical environment, and healthcare access—may inject bias into the results. The dependence on self-reported health status increases the possibility of reporting bias, as individuals may either underreport or over-report their health due to personal circumstances or cultural norms.

6.8 Conclusion

The comparative analysis of health outcomes between Wales and England reveals notable similarities in the determinants of self-reported health, with age, chronic conditions, smoking, and deprivation being identified as primary predictors in both countries. Nevertheless, specific variations indicate that Wales has distinct public health concerns, especially regarding regional health inequalities and the elevated prevalence of poor health among the elderly population. Future public health policies in Wales must consider these disparities while leveraging the effective policy measures previously executed in England.

7 Limitations

This study provides useful insights into the socio-demographic, behavioural, and health-related factors affecting self-reported health outcomes in Wales; nevertheless, numerous limitations must be addressed to ensure a fair interpretation of the data.

7.1 Self-Reported Information

The research predominantly depends on self-reported health information from the National Survey for Wales (NSW). Self-reported measurements may be influenced by recall bias and social desirability bias, as individuals could inaccurately remember prior behaviours or underreport activities such as smoking, alcohol intake, or physical inactivity to portray themselves more favourably (Janz & Becker, 1984). This constraint may impact the validity of the association identified between specific lifestyle behaviours and health outcomes. Future research should integrate objective health metrics, such as medical records or physical health evaluations, to enhance self-reported data.

7.2 Cross-Sectional Design

This study employed a cross-sectional approach, facilitating the analysis of relation between variables at a specific moment, although constraining the capacity to infer causality (Field, 2018). Although notable affiliation between socio-demographic characteristics, health behaviours, and health outcomes were established, the nature of these linkages remains ambiguous. bad health may result in physical inactivity rather than physical inactivity causing bad health. Longitudinal studies are required to determine causal relationships between these factors and examine their progression over time.

7.3 Absence of Data and Selective Omission

Addressing absent data was a problem, particularly for critical variables such as BMI, income, and certain chronic health conditions. The strategy of selective exclusion was employed to address missing data, leading to a diminished sample size. This strategy reduced bias from erroneous imputations, but it may have compromised the generalisability of the findings (Little & Rubin, 2019). The deletion of data with missing values may have eliminated respondents possessing health or socio-economic traits, thereby distorting the results.

7.4 Limited Sample Sizes for Specific Health Conditions

Certain health problems, including rare infectious disorders, have minimal sample sizes, resulting in their elimination from the logistic regression models to maintain model stability (Hosmer et al., 2013). This move enhanced the dependability of the model estimates but constrained the analysis's breadth. The study may not comprehensively reflect the impact of less common yet major health disorders on self-reported health outcomes in Wales. Future research should prioritise larger sample sizes or targeted investigations of rare illnesses to guarantee thorough examination of all health-related variables.

7.5 Restricted Range of Health Determinants

The research concentrated on a narrow spectrum of socio-demographic and behavioural variables, excluding other potentially significant health determinants such as nutrition, genetic

predispositions, air quality, and healthcare accessibility. These factors may significantly impact health outcomes but were excluded from the dataset due to limitations in data availability. Subsequent studies ought to integrate these supplementary variables to yield a more comprehensive knowledge of the determinants of poor health (Rehm et al., 2007).

7.6 Geographic Concentration on Wales

The study's emphasis on the Welsh population restricts the applicability of the findings to other regions or nations with varying socio-economic, cultural, or healthcare situations (Leon, 2011). Although a comparison with England was incorporated, the findings may not be immediately relevant to other regions of the UK or to other countries. Subsequent research should investigate analogous analyses in many places to gain a better understanding of regional disparities in health outcomes and the underlying determinants.

8 Future Work

This study has provided significant insights into the determinants of Healthy Life Expectancy (HLE) in Wales; however, further research is essential in several critical areas. These recommendations are based on the findings and limitations of this study, ensuring continuity without diverting attention from the current research.

8.1 Longitudinal Investigations

A significant disadvantage of this research is its dependence on cross-sectional data, which offers a singular view of the interaction among socio-demographic characteristics, health behaviours, and health outcomes at a certain moment in time. Future studies should utilise longitudinal data to monitor individuals over time, facilitating the development of causal links between factors. Longitudinal research may elucidate whether factors, such as smoking or physical inactivity, directly lead to adverse health outcomes or if deteriorating health prompts individuals to engage in unhealthy behaviours (Field, 2018). This study would aid in the analysis of the influence of early-life conditions and socioeconomic position on health throughout the life span (Marmot & Wilkinson, 2006).

8.2 Expanding the scope of health determinants

This study examined critical characteristics like age, gender, socio-economic position, and health behaviours. Future studies should broaden this reach to encompass additional significant determinants of health, including nutrition, housing conditions, and healthcare accessibility. These variables are crucial to health outcomes, and their inclusion would enhance the understanding of factors impacting HLE in Wales (Rehm et al., 2007). Future research should investigate the impact of geographical characteristics, such as rural versus urban environments, on health inequalities to enhance our understanding of regional variations in health outcomes.

8.3 Assessment of Public Health Interventions

Considering the policy implications of this research, subsequent studies should concentrate on assessing the efficacy of public health measures aimed at enhancing health outcomes in Wales. Future research might evaluate the effects of smoking cessation initiatives, obesity prevention strategies, and accessibility to mental health services on public health, especially in

underprivileged regions. This research would yield essential evidence regarding the efficacy of these interventions in diminishing health disparities and enhancing health-related quality of life. Randomised controlled trials (RCTs) or quasi-experimental designs may be utilised to systematically evaluate the effectiveness of these therapies (Marmot & Wilkinson, 2006).

8.4 Integration of Sophisticated Statistical Techniques

Although logistic regression was appropriate for the present analysis, subsequent research could gain from employing advanced statistical techniques such as multilevel modelling or causal mediation analysis. These methodologies enable researchers to investigate the interplay between community-level factors (such as healthcare accessibility or neighbourhood disadvantage) and individual-level variables in influencing health outcomes (Aburto et al., 2020). Using these methodologies, subsequent studies could provide profound insights into the mechanisms by which diverse variables affect health-related quality of life and health disparities.

9 Conclusion

This thesis has effectively examined the socio-demographic, behavioural, and health-related determinants affecting self-reported health outcomes in Wales. This study utilises data from the National Survey for Wales (NSW) to elucidate the determinants of poor health, focussing specifically on age, socio-economic deprivation, chronic health issues, and detrimental behaviours such as smoking and obesity (Welsh Government, 2023).

The data substantiates the substantial impact of socio-economic disparities on health outcomes in Wales, where persons from more disadvantaged regions experience poorer health outcomes. Smoking and physical inactivity significantly affect health outcomes, underscoring the necessity for focused public health initiatives to tackle detrimental behaviours and socio-economic disparities (Wanless, 2006; Marmot & Wilkinson, 2006).

The results underscore the significant impact of chronic conditions—especially neurological illnesses, musculoskeletal problems, and mental health issues—on overall health, necessitating enhanced techniques for chronic disease treatment (Walsh et al., 2021). The study demonstrates the significance of developing health care tailored to the unique needs of the community in Wales.

This study emphasises common issues in tackling health inequities and fostering healthier behaviours, akin to comparable analyses from England, but also reveals regional distinctions that require customised public health initiatives for Wales (McGowan et al., 2021).

This research paves the way for future studies to utilise longitudinal data, enhancing our comprehension of the causal links among socio-demographic characteristics, health behaviours, and health outcomes (Field, 2018). In addition, a future study could look at factors like housing quality, nutrition, and access to health care, among others, to get a fuller picture of the things that affect Healthy Life Expectancy (HLE) in Wales (Rehm et al., 2007).

This study has clarified the determinants affecting health outcomes in Wales and established a foundation for public health policy designed to mitigate health inequities. Addressing social

determinants of health, enhancing healthcare access, and advocating for healthy lifestyles are crucial measures for boosting Healthy Life Expectancy in Wales.

References:

- Aburto, J.M., et al., 2020. Dynamics of life expectancy and life span equality. *PNAS*, 117(10), pp. 5110-5120.
- Allen, J., Bellis, M.A., Hughes, K., Ford, K., Rodriguez, G.R. & Lea, A., 2015. Public Health and Economic Outcomes. *BMC Public Health*, 15(1), p.1561.
- Delany, T., Harris, P., Williams, C., Harris, E., Baum, F., Lawless, A., MacDougall, C., Broderick, D. & Kickbusch, I., 2014. Health Impact Assessment in New South Wales & Health in All Policies in South Australia. *BMC Public Health*, 14(1), 699.
- Field, A., 2018. *Discovering Statistics Using IBM SPSS Statistics*. 5th ed. London: Sage.
- Hiam, L., Dorling, D., Harrison, D. & McKee, M., 2017. Why has mortality been increasing in England and Wales? An iterative demographic analysis. *Journal of the Royal Society of Medicine*, 110(4), pp. 153-162.
- Hosmer, D. W., Lemeshow, S., & Sturdivant, R. X., 2013. *Applied Logistic Regression*. 3rd ed. Hoboken: Wiley.
- Hunt, K., et al., 2009. Sex, gender role orientation, gender role attitudes and health. *Social Science & Medicine*, 68(7), pp. 1375-1384.
- James, G., Witten, D., Hastie, T., & Tibshirani, R., 2013. *An Introduction to Statistical Learning*. New York: Springer.
- Janz, N. K., & Becker, M. H., 1984. The Health Belief Model: A decade later. *Health Education Quarterly*, 11(1), pp. 1-47.
- Kadel, R., et al., 2022. Chronic conditions and self-reported health outcomes in aging populations. *Journal of Aging Research*, 2022, Article ID 561234.
- Kadel, R., Allen, J., Darlington, O., Masters, R., Collins, B., Charles, J.M., Asaria, M., Dyakova, M., Bellis, M., & Cookson, R., 2022. Cost of health inequality to the NHS in Wales. *Frontiers in Public Health*, 10, 959283.
- Leon, D.A., 2011. Trends in European life expectancy: A salutary view. *International Journal of Epidemiology*, 40(2), pp. 271-277.
- Little, R. J., & Rubin, D. B., 2019. *Statistical Analysis with Missing Data*. 3rd ed. Hoboken: Wiley.
- Marmot, M., & Wilkinson, R., 2006. *Social Determinants of Health*. 2nd ed. Oxford: Oxford University Press.

- Marshall, L., et al., 2014. Ageing and health: The role of chronic diseases. *The Lancet*, 383(9923), pp. 1031-1039.
- McGowan, M., Rees, J., & Lewis, G., 2021. Life expectancy inequalities in Wales before COVID-19. *Public Health Wales*.
- OHID (Office for Health Improvement and Disparities), 2023. Understanding the drivers of healthy life expectancy.
- Polizzi, L., et al., 2024. Exploring the role of healthcare systems in public health outcomes. Unpublished report.
- Prochaska, J. O., & DiClemente, C. C., 1983. Stages and processes of self-change of smoking: Toward an integrative model of change. *Journal of Consulting and Clinical Psychology*, 51(3), pp. 390-395.
- Rees, P., Wohland, P., Norman, P., & Boden, P., 2012. The demographic drivers of future ethnic group populations for UK local areas: 2001–2051. *The Geographical Journal*, 179(1), pp. 144-160.
- Rehm, J., Sulkowska, U., & Manczuk, M., 2007. Alcohol accounts for a high proportion of premature mortality in Central and Eastern Europe. *International Journal of Epidemiology*, 36(2), pp. 458-467.
- Walsh, C. A., et al., 2021. Physical activity, mental health, and well-being in the context of chronic illness. *Public Health Research*, 10(4), pp. 1-12.
- Walsh, D., McCartney, G., Minton, J., Parkinson, J., Shipton, D., & Whyte, B., 2021. Deaths from diseases of despair in Britain. *Journal of Epidemiology & Community Health*, 75(11), pp. 1195-1201.
- Wanless, D., 2006. Tackling obesity: Future choices. *UK Government Report*, London.
- Waite, L. J., & Gallagher, M., 2000. *The Case for Marriage: Why Married People Are Happier, Healthier, and Better Off Financially*. New York: Doubleday.
- Welsh Government, 2015. Well-being of Future Generations (Wales) Act 2015.
- Welsh Government, 2019. Health and Social Care in Wales: Overview.
- Welsh Government, 2023. National Survey for Wales: 2021-2023.
- Whynes, D.K., 2008. Deprivation and self-reported health: Are there 'Scottish effects' in England and Wales? *Journal of Public Health*, 31(1), pp. 147-153.