

Lung cancer inequalities in Wales: Investigating the relationship between deprivation, smoking and lung cancer inequalities.

Emily Heath

Supervisor – Dr Maddy Young

Contents

Abstract.....	1
Lay summary.....	2
Key recommendations.....	2
Scope and limitations	3
Key Aims.....	3
1. Background	4
Deprivation in Wales.....	4
Health inequalities in Wales	4
Lung cancer inequalities	5
The effect of Covid-19 on existing inequalities.....	5
2. How does smoking relate to deprivation?.....	7
Income domain	7
Employment domain	7
Health domain.....	8
Education domain	8
Access to services domain	9
Housing and community safety domains.....	9
Physical environment domain	10
3. Lung cancer inequalities – deprivation.....	11
Smoking and deprivation	11
Lung cancer incidence and mortality	12
Lung cancer survival.....	14
Recommendations	15
4. Geographical lung cancer inequalities	16
Smoking.....	16
Lung cancer incidence	18
Stage at diagnosis.....	19
Wait times.....	20
Lung cancer mortality	22
Aneurin Bevan UHB case study	23
Recommendations	25
5. Lung cancer inequalities – Sex.....	26
Smoking inequalities.....	26

Incidence and mortality	27
Survival	28
Tumour stage at diagnosis	29
Recommendations	30
6. Smoking Cessation.....	31
Current use of NHS smoking cessation services in Wales	31
Barriers to smoking cessation	34
Recommendations	37
7. Lung health checks and screening	38
Recommendations	40
8. Conclusions and recommendations.....	42
References	44
Appendix 1. Methods used in this report.....	51
Lung cancer incidence and mortality	51
Tumour stage at diagnosis	51
Smoking cessation data	51
Appendix 2: FOIs used in this report.....	52

Abstract

Health inequalities exist in Wales and are related to wider socio-economic inequalities. Lung cancer is no exception to this, in fact, it is one of the main drivers of health inequalities. Lung cancer inequalities are largely driven by smoking inequalities which relate to deprivation. This report explores the relationship between smoking and deprivation and how this drives lung cancer inequalities in Wales. The inequalities in smoking and lung cancer were investigated across income deprivation groups, geography at a health board and local authority level and sex. Inequalities were investigated using lung cancer incidence, survival, mortality and tumour stage data from WCISU and lung cancer wait time data, smoking rates and smoking cessation rates from StatsWales data. Lung cancer and smoking inequalities were associated with financially deprived populations. Inequities in smoking and lung cancer incidence were found across geographical areas where they likely related to relative levels of deprivation. Inequalities between sexes were reported with males having higher lung cancer burden and worse outcomes, although the links between inequality and sex may be more complex than originally thought. To tackle these inequalities a greater focus needs to be placed on lung cancer prevention and early detection. To this end, it is recommended that smoking cessation programmes and lung cancer screening is targeted at more deprived population groups. However, further adding to the inequalities, a range of barriers to smoking cessation and lung cancer screening have been identified in these groups. It is important that more is done to improve suitability of these services and enhance engagement with target groups.

Lay summary

Lung cancer is the biggest cause of cancer death in Wales, but it is not experienced equally. Some groups of people experience higher rates of lung cancer than others. People experiencing income deprivation are more likely to develop lung cancer. Not only that, but once within the healthcare system they are also more likely to face differences in treatment and lower survival. In Wales, there are areas where individuals are more likely to develop lung cancer, and this is likely related to the levels of deprivation. Deprivation does not only mean that an area is poorer, but it also can mean that people within that area have less access to services like GPs and lower educational level. Lung cancer is also not experienced equally between men and women in Wales. Men are more likely to develop lung cancer and unfortunately also have a lower chance of survival. However, it is becoming clear that women may also face lung cancer inequalities with an increased risk of lung cancer with a lower smoking history.

There are several reasons why people develop lung cancer but the most common is through smoking. In fact, smoking is thought to be the biggest driver of these inequalities. There are several well-known reasons why smoking is more common among more deprived groups. These include using smoking as a coping mechanism for increased life stress, the belief that smoking is more common than it is and passing smoking behaviour down through generations. But it is more than just smoking behaviour that drives these inequalities. More deprived groups face greater challenges to quit smoking, experience lower cancer symptom awareness and greater reluctance to seek help from the healthcare system.

In this review project, we have explored why there are higher smoking rates in more deprived areas and what can be done to tackle these inequalities. Lung cancer prevention and early detection are the best ways to prevent lung cancer deaths and tackle these inequalities. To do this, quit smoking support services can improve their engagement with more deprived groups, and make sure that their services are designed to help smokers in more deprived areas to overcome barriers on their journey to stopping smoking. Screening programmes should also be introduced in Wales to detect lung cancer at an early stage. This would give people better treatment options and increased likelihood of survival. However, we know that people living in more deprived areas are less likely to engage with these screening services, therefore they need to be designed to target these groups and encourage uptake of screening.

Key recommendations

1. Consider other forms of deprivation than income for links between deprivation, smoking and lung cancer e.g. educational deprivation.
2. Target smoking cessation services at more deprived groups and introduce lung cancer screening in Wales to tackle inequalities in these groups.
3. More data must be gathered at a local authority level to enable us to explore geographical inequalities in Wales at a deeper level.
4. Lung cancer and smoking inequalities by sex should be given more consideration so that screening and smoking cessation support can be appropriately tailored.

Scope and limitations

The main purpose of this report is to explore lung cancer inequalities in Wales across deprivation groups, geographies and sex in terms of incidence, staging, survival and mortality. An emphasis is placed on smoking as a driver of these inequalities and as such the relationship between smoking and different measures of deprivation is explored. Through this, more deprived groups that would benefit from more targeted cessation support are identified. The report focuses on lung cancer prevention via targeted smoking cessation services and early lung cancer detection via screening as ways to tackle these inequalities. The increased barriers faced by more deprived groups to smoking cessation and lung cancer screening were discussed with the aim to highlight how these services need to be tailored to overcome these and engage more deprived groups.

There were several limitations to this report. The report primarily focuses on smoking as a driver of lung cancer inequalities and did not consider other contributing factors extensively, and no focus was placed on the proportion of lung cancers experienced by 'never smokers'. The report also did not include a detailed analysis of health boards in Wales and how they may differ in terms of facilities and funding which may impact on lung cancer care and outcomes. It is important to note that although the report was written in the context of the Covid-19 pandemic and the major disruptions it caused to cancer services, there is little focus on the impacts of Covid on lung cancer inequalities. Much of the data discussed here is from pre-Covid due to the age of the data available.

Of note, in the geographical analysis Bridgend was included in the Cwm Taf Morgannwg health board despite being part of the Swansea health board at the time of data collection. This is due to Bridgend moving to the Cwm Taf Morgannwg health board in 2019, therefore it is logical to include it as part of this updated health board as any data on inequalities will now affect this health board. Additionally, Powys THB has been excluded from the analysis due to a lack of cancer treatment facilities resulting in patients being treated in alternative health boards.

Key Aims

1. Investigate the lung cancer inequalities that exist in Wales in terms of incidence, survival and mortality across deprivation areas, geography and sex. This will enable identification of groups that would benefit from a targeted approach to tackling lung cancer inequalities.
2. Explore how smoking relates to different measures of deprivation and how this drives lung cancer inequalities. An understanding of this would allow better targeted cessation support for people from more deprived groups.
3. Evaluate the barriers to smoking cessation and engagement in lung cancer screening faced by more deprived groups, to enable adaptations to the services which actively reduce inequalities.

1. Background

Deprivation in Wales

Inequalities in Wales are a substantial problem with 23% of the population experiencing relative income poverty between 2017-18 and 2019-20 (1). Several groups are more likely to experience income poverty, including:

- Young people
- People living with disabilities
- Ethnic minorities
- Workers with no educational qualifications
- Those living in social and rented housing (2).

Deprivation does not simply refer to income, and deprivation can be experienced as a result of inadequate access to services which can influence education, employment, housing and health. In Wales, the overall deprivation of areas is measured using the Welsh Index of Multiple Deprivation (WIMD) and is reported at small area Census geographies called Lower-layer Super Output Areas (LSOAs) (3). Relative deprivation is measured by a ranking system by which areas in Wales are compared to one another i.e. LSOAs are ranked in terms of deprivation from 1 (most deprived) to 1909 (least deprived) (3). The WIMD is comprised of 8 domains each of which contribute to the overall score and are weighted differently according to perceived importance - Income (22%), Employment (22%), Health (15%), Education (14%), Access to services (10%), Housing (7%), Physical environment (5%) and Community safety (5%) (3). The WIMD allows you to see the overall inequalities in relative deprivation levels which exist across Wales and explore the inequalities which exist within each domain (4).

Health inequalities in Wales

Health inequalities exist both within Wales and the UK as a whole. Health inequalities are avoidable, unfair differences in the health status between groups of people or communities (5). This problem has been recognised for many years, from the seminal work in the 1980 Black report which highlighted health inequalities that exist in the UK (6) to more recent work such as the Marmot review of 2010 (7) and its follow-up in 2020 (8) which show that these inequalities continue to persist. Social gradients of health exist, and these are related to wider inequalities within society, with the most deprived groups experiencing worse health outcomes (7). These health inequalities can be observed in differences in life expectancy and healthy life expectancy in Wales. For example, there is around a 9-year difference in life expectancy for males between the most and least deprived groups and this increases to around 19 years for healthy life expectancy (9). These health inequalities related to deprivation can also be seen at a geographical level, for example the life expectancy of a male at birth in Blaenau Gwent is 76 years compared to 80.5 years in Monmouthshire (2010-14) (9). One of the biggest drivers of these health inequalities is tobacco use (10) with smoking rates in the most deprived quintile in Wales more than double those in the least deprived quintile (11).

Lung cancer inequalities

Smoking is the biggest risk factor for lung cancer, responsible for more than 70% of cases (12). Importantly, smoking has been identified as the single biggest driver of health inequalities in England (10). Lung cancer is no exception to the pattern of health inequalities, in fact it is one of the drivers of these inequalities. There are around 2500 cases of lung cancer a year in Wales, but this is not experienced equally across the population, with the most deprived groups experiencing the greatest burden (13).

The effect of Covid-19 on existing inequalities

It is also important to highlight how all these existing inequalities in Wales and the UK as a whole have been exacerbated as a result of the Covid-19 pandemic. Covid-19 has had an impact on income and employment inequalities, both worsening existing ones and creating new ones. During lockdowns 22% of households lost at least 20% of their income creating financial insecurity coupled with rising unemployment (14) (15). Covid-19 has also exposed flaws in the housing system with unequal access to green and blue spaces and overcrowding risk (15). This is in addition to unequal lockdown experiences, with a digital divide becoming apparent which impacted on education as learning moved online with children living in deprived areas less likely to have access to the resources required to support their learning (15). This experience has further ingrained existing educational inequalities and some groups were at higher risk of detrimental impacts on mental health (15).

The Covid-19 pandemic widened the health inequalities that exist in Wales and the wider UK. Covid-19 itself was inequitably experienced as Covid hospital admissions and death rates were 2x higher in the most deprived areas of Wales compared to the least (15). In addition, there were other effects on healthcare and related inequalities. Covid-19 and the related 'stay at home' messages led to lower help seeking behaviour due to people not wanting to overwhelm the NHS and concerns about covid safety (16), and this may have particularly affected some groups such as those with existing health conditions who were required to shield. The evidence of these effects is clear as there were major decreases in elective and emergency hospital admissions (55% elective 30% emergency) in 2020 compared to 2019 (15).

Covid-19 also caused disruption to cancer services. Although essential cancer services and treatments were maintained throughout the pandemic in Wales, they were disrupted due to adaptations for Covid-19 safety (17). Macmillan reported in their 'The Forgotten C' report that during the initial peak of the pandemic March-April 2020, the number of patients entering the single cancer pathway in Wales fell dramatically with the lowest numbers in April which equated to a 61% drop in referrals compared to pre-pandemic levels. Overall, there was a 31% decrease in the number of patients entering the pathway between March-August which may have resulted in a significant number of missed diagnoses during this period (17). Additionally, during the pandemic waiting lists for diagnostic procedures such as endoscopy grew considerably (17). Further to this, screening programmes including bowel, breast and cervical were temporarily paused during the initial part of the pandemic potentially adding to the number of missed diagnoses during this period (17). Of note, during this time NHS Wales reporting against the single cancer pathway was paused to ease pressure on the NHS (18) potentially also adding to delays in diagnosis and treatment.

In addition to general disruption to cancer services, lung cancer is likely to have been particularly affected as it is a respiratory disease. In England during the pandemic there was a large drop in urgent lung cancer referrals, a reduction in access to diagnostic services such as chest X-rays, PET scans and CT scanning and a reduction in lung cancer specific surgery (19). Changes in help-seeking behaviour is also likely to have had a big impact on the drop of lung cancer diagnoses. One study in the UK showed that just under 45% of people surveyed who experienced a potential cancer symptom did not contact their GP during the first six months of the pandemic, this included red flag symptoms such as coughing up blood, 30.7% of people with this symptom did not seek help (16). Several barriers to help seeking behaviour were identified including worries about wasting the doctors time, putting strain on the healthcare system and reluctance to contact GPs due to concerns over Covid-19 and fear of attending hospitals (16).

In lung cancer even short delays to diagnosis and treatment can have big impacts on outcomes for patients with the disease progressing to an advanced stage where curative treatments are no longer an option (19). It is likely that similar patterns of disruption to lung cancer diagnosis and treatment may have occurred in Wales compared to England, however the data on this is currently lacking and the full of effects of the pandemic will not be realised until more data is released. However, some early data and reports suggest that disruption to lung cancer diagnosis and treatment in Wales may not have been as heavily disrupted as first feared with an apparent 3.8% reduction in the number of patients starting treatment for lung cancer in 2020 compared to 2018/19, compared to around an 8.5% reduction for all cancers (20). This could be because lung cancer is more likely to be diagnosed via emergency presentation than some other cancers or that lung cancer may have been picked up in Covid-19 patients via chest scans. Either way the full effects of the pandemic are not likely to be realised until all data for this period becomes available. It is important to consider that the pandemic likely will have had an effect on the lung cancer inequalities discussed in this report. However, the impacts of Covid-19 do not form part of this investigation due to the age of the data available. Future work will be needed to evaluate how the Covid-19 pandemic impacted lung cancer inequalities in Wales.

2. How does smoking relate to deprivation?

Smoking and its relation to deprivation acts as a driver of lung cancer inequalities in Wales. Smoking rates correlate with income deprivation and is the main driver of lung cancer incidence/mortality (see section 3). Therefore, to understand how deprivation and lung cancer inequalities are linked we must first explore the links between smoking and deprivation.

Associations between smoking and deprivation is not just a pattern observed in Wales. In England for example, it has been reported that the highest smoking rates are found in local authorities that rank within some of the most deprived areas (21). There are numerous factors involved in this relationship such as normalisation of smoking in these areas, intergenerational transmission of smoking behaviour and use of smoking as a coping mechanism for stress caused by life circumstances (22) (23). Typically, when discussing the links between lung cancer, smoking and deprivation it is income deprivation which is used as a measure, indeed the WCISU deprivation data presented in section 3 is based upon the WMID income deprivation domain. In order to tackle smoking inequalities, we must first understand the reasons for increased smoking rates associated with deprivation. Here, each individual domain of the WIMD and its possible relationship with smoking rates will be explored with the aim of looking beyond the income domain as a measure of deprivation that links smoking and associated health inequalities.

Income domain

This domain captures material deprivation and income poverty and is often used when looking at the links between smoking and deprivation. The links between this deprivation domain and smoking are clear as shown in section 3, where smoking rates are more than double in the most financially deprived population quintile compared to the least deprived. There are several factors which may contribute to the higher smoking rates in more income deprived populations such as increased stress related to financial issues (10) (22). Additionally, it has been suggested that individuals on low incomes may be less likely to consider the long-term risks of unhealthy behaviours such as smoking and prioritise future health when compared to the short-term negative impacts of giving up smoking such as withdrawal symptoms and losing a coping mechanism (24) (10). Concerns that quitting smoking could add to already stressful life circumstances for individuals experiencing income deprivation have also been identified and suggested as a barrier for charitable financial advisers approaching the subject with clients, despite the financial benefits of smoking cessation (25).

Employment domain

This domain is measured by the percentage of the working age population in receipt of employment-related benefits (3). Employment is something which has been often linked to smoking prevalence, for example ONS data 2019 showed that in the UK the smoking rate amongst those employed in routine and manual jobs was 23.4% compared to 9.3% for those working in managerial and professional occupations (26). Similarly, links between smoking and unemployment have been reported, for example ONS data 2019 showed that the smoking rate amongst unemployed people in the UK was 26.8% compared to 14.5% for those in regular employment (26).

There are two sides to the relationship between smoking and unemployment. The first is that higher levels of unemployment lead to increased smoking rates. Some studies have suggested that this association is largely due to factors such as stress, emotional isolation and the feeling of inability to control important matters in their lives (27). The other side to this relationship is that smoking related disabilities result in increased levels of unemployment. A study by ASH on the relationship between smoking, employability and earnings found that current smokers are 5% less likely to be employed than non-smokers which increases to 7.5% for long term-smokers (28). This report found that almost all of this relationship is explained by levels of disability (28). The report suggests that disability and ill-health leaving people unable to work as a result of smoking, particularly long-term smoking, is a key factor in explaining the relationship between smoking and higher unemployment (28). This relationship highlights the interplay between deprivation domains, with health and employment being tightly linked. It could be that there is a combination of both unemployment driving higher smoking rates and smoking driving higher unemployment rates but either way employment deprivation is an important factor to consider in smoking and therefore lung cancer inequalities.

Health domain

This domain relates to health within the population. It includes GP recorded diagnosis of chronic conditions and mental health conditions, cancer incidence and premature death rate, among other measures (3). In some ways discussing the links between health deprivation and smoking rates is unavoidable due to the large number of smoking related illnesses and unemployment caused through smoking related disability. However, less of a focus is put on the links between health deprivation and smoking rates compared to domains such as income deprivation.

There are other links between the health deprivation domain and smoking. For example, adults living with disabilities in the UK have been shown to be more likely to smoke than adults not living with disabilities (29). These higher rates of smoking among people living with disabilities may be related to higher levels of stress, poorer mental health, and less support to quit smoking (30). The health domain also encompasses people with GP diagnosed mental health conditions. This may be an important factor when looking at smoking related inequalities as smoking rates are around 50% higher among people with mental health conditions (31). Mental health also links to other domains with some factors such as income, employment and housing exacerbating mental health conditions, with one of the reasons suggested for smoking being higher in this group is due to 'self-medicating' and feeling that smoking helps relieve stress (31) (24). This is coupled with the finding that there is inadequate support for smoking cessation within mental health care settings both within in-patient and community services setting (31). These findings highlight that the health domain should be given more consideration when talking about smoking inequalities and the resultant health inequalities including lung cancer. It also shows that people living with disabilities and mental health conditions should be given more consideration in targeted approaches for lung cancer health campaigns and smoking cessation services.

Education domain

This domain captures the level of education deprivation in terms of lack of qualifications and skills. The domain is made up of several indicators including the average points score at multiple educational levels e.g. key stage 2, repeat absenteeism, the proportion of key stage

4 leavers entering higher education and the number of adults aged 25-64 with no qualifications (3). Education levels are commonly linked to smoking rates, for example ONS 2019 data reported that smoking rates were 29.1% among people with no qualifications in the UK compared to only 7.3% amongst those with a degree (26).

Several studies have linked lower education levels to increased smoking rates (32) (33). There are several possible reasons for this link between lower education level and increased smoking, for example it has been suggested that it is caused by differing levels of health-related knowledge and the risks associated with smoking (34) (24). However, it is likely that the effects of education go further than this. A significant proportion of smokers begin smoking in adolescence when the impact of education and school is at its highest, and it has been suggested that school performance and peer pressure at school have a role in smoking uptake (33). Additionally, education level and skills are likely to impact on employment prospects, suggesting further links between educational deprivation and employment deprivation which are both associated with increased smoking.

Access to services domain

This domain accounts for travel times to different services such as food shops, GP surgeries, pharmacies and schools in addition to internet access below a certain broadband speed (3). There are multiple ways access to services may impact on smoking rates potentially having both a positive and negative impact. The first is that access to services deprivation may increase smoking rates, or at least stall their decline due to its influence on help seeking behaviours via difficulties in accessing NHS smoking cessation services e.g. from GPs and pharmacies, which are a more effective way to quit smoking compared to going it alone (35). Therefore, use of smoking cessation services should be recorded and published at a local authority level in addition to local health board level, to understand inequalities in access to these services. However, in contrast to this, less access to services deprivation may also relate to increased smoking rates due to the increased availability of tobacco products. A study in Scotland found that there were a greater number of tobacco outlets in more income deprived areas and suggested this could be a contributing factor to driving smoking inequalities (36).

Housing and community safety domains

The housing domain measures inadequate housing through proportion of overcrowding and a modelled indicator measuring the likelihood of housing to be in a state of disrepair or containing a serious hazard (3). The community safety domain is a measure of crime rates and fire incidences within an area. Although it is unlikely that these domains are the biggest drivers of smoking inequalities, there may still be an association between them and smoking rates and there are links to other deprivation domains. For example, living in poor quality or overcrowded housing or living within areas with high rates of community safety deprivation can lead to increased stress and exacerbate mental health conditions (37), which as previously discussed may lead to using smoking as a coping mechanism. Additionally, this domain may relate to the income and employment domains, with low-income families more likely to live in overcrowded conditions (37).

Physical environment domain

This domain takes into account the average concentrations of nitrogen dioxide and particulates $< 10 \mu\text{m}$ (PM10) and $< 2.5 \mu\text{m}$ (PM2.5), in addition to access to natural green space, ambient green space score and flood risk (3). The Physical environment domain is more likely to be independently linked to increased lung cancer risk rather than increased risk via increased smoking rates, as air pollution itself is a lung cancer risk factor thought to cause 1 in 10 lung cancers (38). This makes this domain important to consider when talking about lung cancer inequalities, as there is a big difference between the relative levels of physical environment deprivation between different geographical areas. This also relates to other deprivation domains as low-income families are more likely to live in areas with the highest air pollution (39), further compounding other inequalities which relate to health. It is important to remember that smoking is thought to cause around 9x more lung cancer incidences than air pollution (38) (40), therefore, its effect on lung cancer inequalities will be less than smoking however it is still an important factor to consider.

This section has highlighted how different measures of deprivation that form the WIMD can be related to smoking rates. This shows that there is a need to look beyond income deprivation to understand how deprivation and smoking are linked, other domains such as health, education and employment also play important roles. This is subsequently important when considering how deprivation and lung cancer are linked. Importantly physical environment deprivation may also link directly to lung cancer inequalities independently of smoking rates, as air pollution is also a lung cancer risk factor. Therefore, physical environment is another domain that should be given more consideration when discussing lung cancer inequalities.

3. Lung cancer inequalities – deprivation

Lung cancer is not experienced equally throughout the population and links between lung cancer and deprivation have been widely discussed (41) (42) (43) (44). There are a multitude of factors which contribute to this inequality, one of the most important being a higher exposure to risk factors which in the case of lung cancer is primarily smoking (40) (41). Further to this there are other factors which contribute to worse lung cancer outcomes for lower socio-economic status groups such as lower awareness of symptoms and reporting more barriers to seeking help (45) and it has been reported that people from deprived groups are more likely to be diagnosed via emergency presentation for some cancers (46) (41). Lung cancer inequalities related to socio-economic deprivation is a problem across the UK (41) (42) and Wales is no exception to this. In this section data are shown to highlight the inequalities of lung cancer in more deprived groups. The data discussed here relates to income deprivation based on WIMD.

Smoking and deprivation

The links between smoking and lung cancer risk are well documented. The Welsh government has made a strong commitment to drive down smoking rates in Wales and set a goal to achieve a smoke free Wales by 2030 (47). Although there has been a steady decline in smoking in Wales over the past decade and beyond (48), the smoking rates among several population groups has remained higher than the general population figure, including economically deprived groups. The links between smoking and deprivation have been widely explored and smoking is thought to be the biggest contributor to health inequalities between those in the most and least deprived groups.

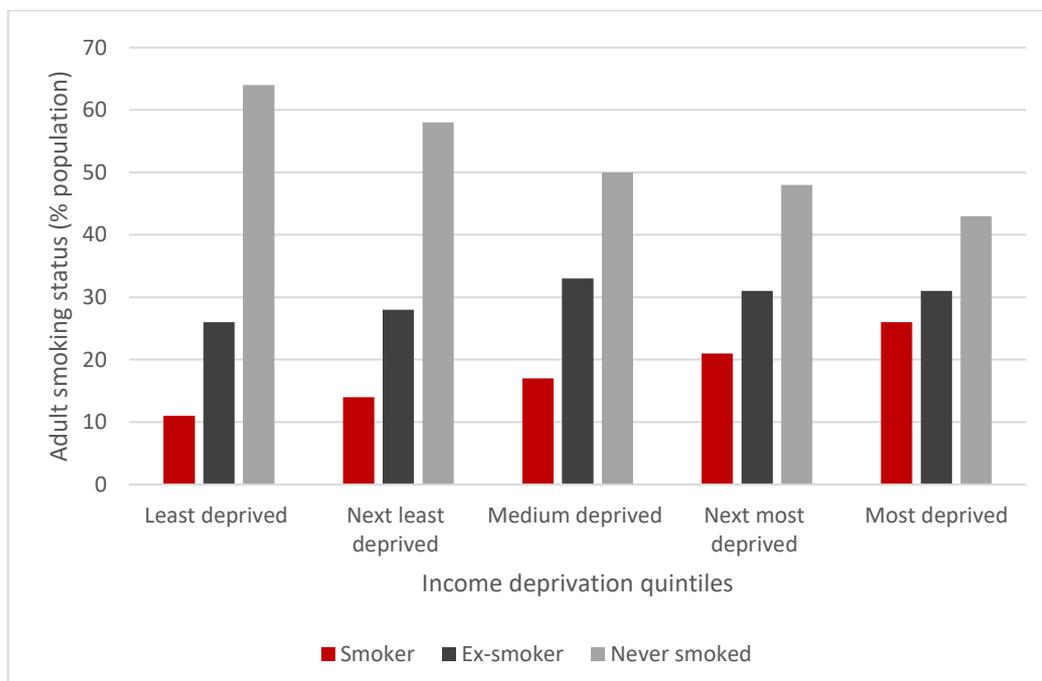


Figure 1. Smoking rates by percentage of adults aged 16+ in Wales 2019-20. StatsWales Data (11).

Figure 1 shows that the proportion of smokers is more than double in the most deprived group compared to the least deprived, (26% compared to 11% respectively). Similarly, the

proportion of 'Never-smokers' is 21% higher in the least deprived group compared to the most deprived group.

This pattern of increased smoking rates among more socio-economically deprived groups is observed similarly across the whole of the UK (21) (26). There are several reasons why smoking rates are higher among people living in more deprived areas, including normalisation in these economically deprived areas and a cycle of intergenerational smoking transmission with children 70% more likely to start smoking if one parent does than if neither does (10) (22). The problem of increased smoking rates in these groups is also exacerbated by the fact that in some areas a prevalence of illegal tobacco products makes smoking more affordable and accessible (49). Additionally, it has been shown that although people from more socio-economically deprived groups make as many smoking cessation attempts as people from less deprived groups their success rate is lower (see section 6), which further contributes to the continuing pattern of smoking and health related inequalities.

Lung cancer incidence and mortality

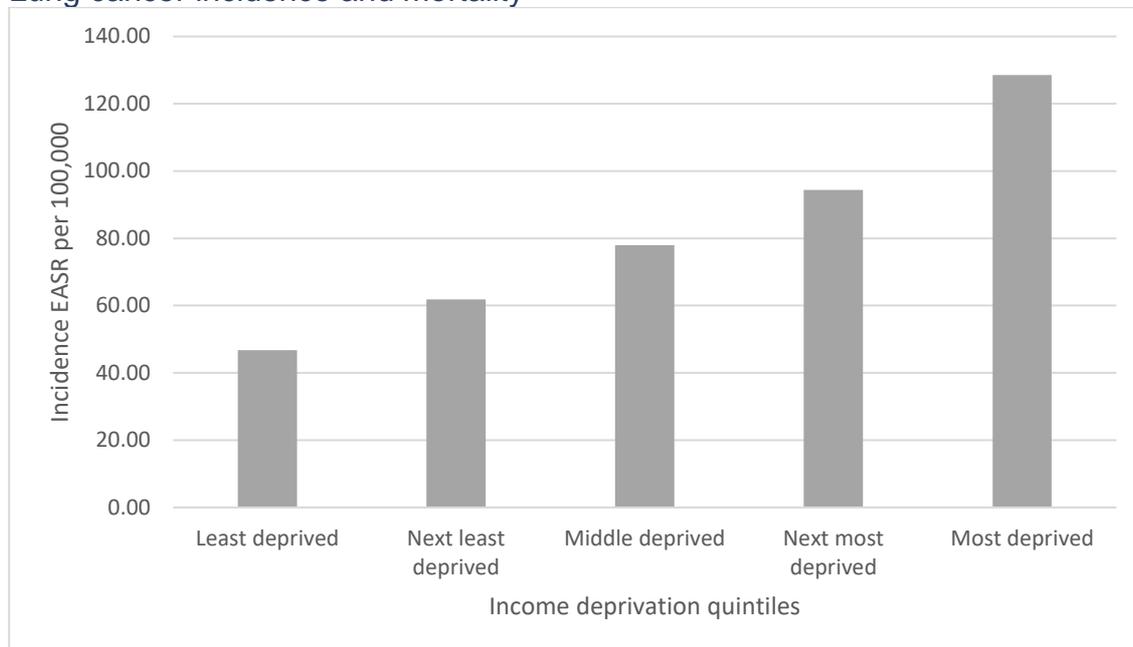


Figure 2. European Age standardised rates for lung cancer incidence in Wales across deprivation fifths 2016-2018. WCISU Data (13).

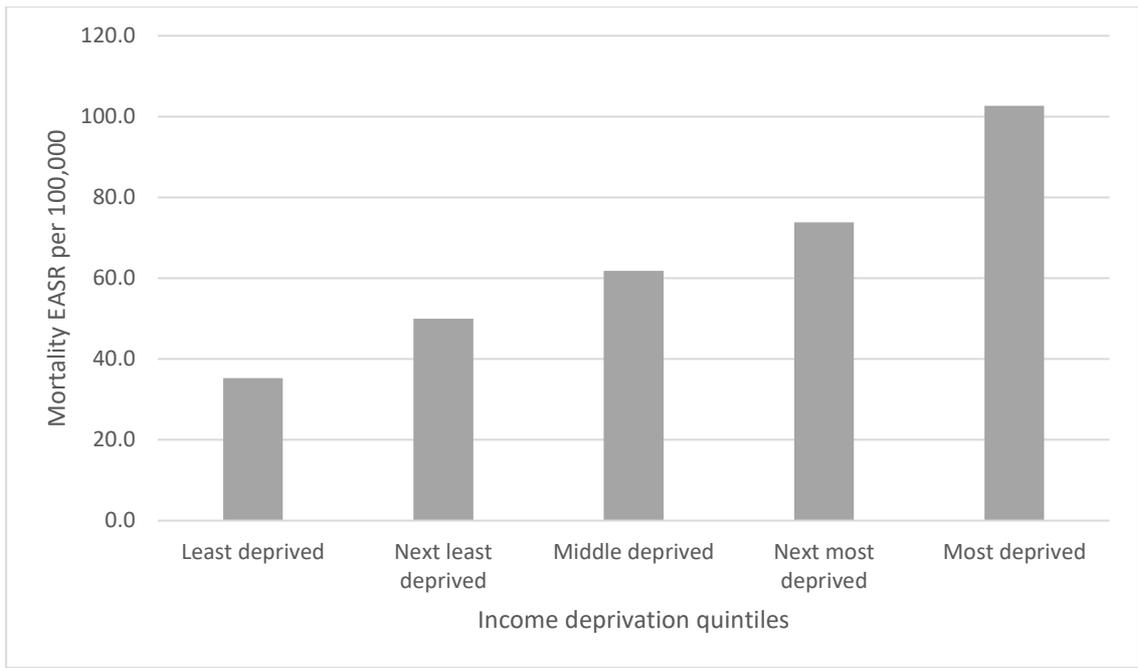


Figure 3. European Age standardised rates per 100,000 for lung cancer mortality in Wales across deprivation fifths 2013-2017. WCISU Data (50).

As shown in figure 2, the rates of lung cancer incidence per 100,000 people are 2.75x higher in the most deprived fifth compared to the least deprived fifth (128.6 and 46.8 per 100,000 people respectively). Similarly, the rates of lung cancer mortality per 100,000 people are 2.9x higher in the most deprived fifth compared to the least deprived, as shown in figure 3 (102.7 and 35.3 per 100,000 people respectively). There is a clear gradient showing increasing lung cancer incidence rates with increasing deprivation quintiles. These patterns of inequalities in lung cancer burden across deprivation fifths are similar to the observed inequalities in smoking rates, highlighting the important role smoking has in driving these lung cancer inequalities.

Lung cancer survival

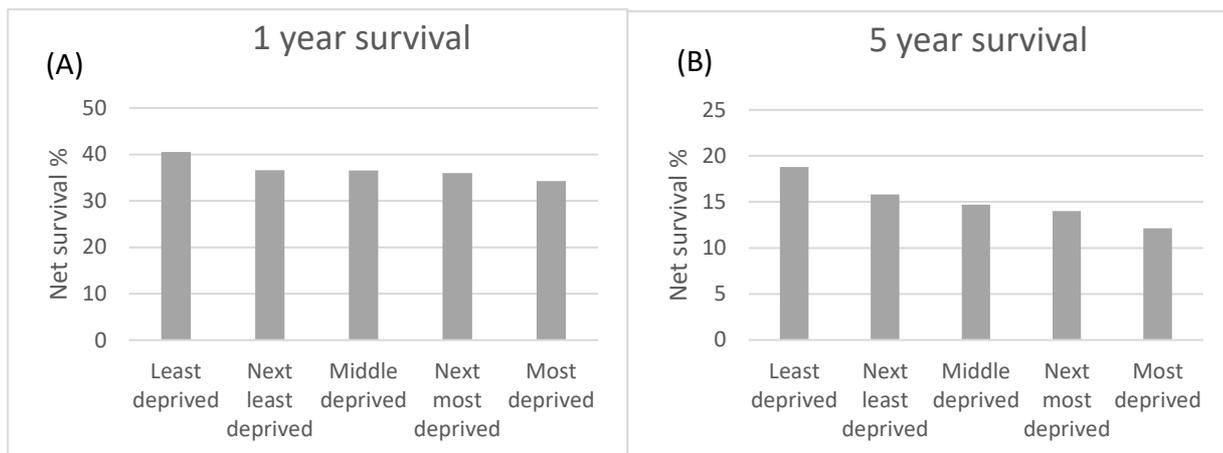


Figure 4. (A) Net 1-year survival rates per deprivation fifth between 2014-2018. (B) Net 5-year survival rates per deprivation fifth between 2014-2018. WCISU Data (51).

Overall, the survival rates for lung cancer are very poor, especially when compared to other cancers such as breast cancer which has a 1-year survival rate of just over 96% (51). However, within this survival data there are also inequalities based upon deprivation fifths. Figure 4A shows that individuals in the most deprived fifth have just over 6% lower 1-year survival rates compared to the least deprived. As shown in figure 4B, the same pattern of inequality is observed for 5-year survival, individuals in the most deprived fifth have just over 6.5% lower survival compared to the least deprived.

The reasons for this inequality in lung cancer survival are complex and multifaceted. However, there are several factors which may contribute to this. It has been reported that people in lower socio-economic groups were less aware of certain cancer symptoms, with links between unemployment, lower education level and residency within deprived areas with lower recognition of cancer symptoms (45). In addition to this, the same study found that people from lower socio-economic groups generally report more barriers to symptomatic presentation, particularly emotional barriers such as fear of what may be found, embarrassment, and more prevalent fatalistic beliefs about cancer (45). It has also been shown that more people living in the most deprived areas are diagnosed with lung cancer via emergency routes compared to those living in the least deprived areas (46) (41), which may be related to this lowered awareness of symptoms and increased barriers to seeking help.

Further to this, there is evidence that once within the healthcare system there are inequalities with regards to treatment received, with those from more deprived areas less likely to undergo surgery to treat non-small cell lung cancer (NSCLC) (52). The same study found that there were clear geographical inequalities in terms of the rates of lung cancer surgery across NHS Primary Care Trusts in England (52), which may be one of the contributing factors to treatment inequalities across deprivation groups. It has been suggested that distance and access to treatment, especially specialist treatment, may contribute to inequalities (53). Another study has shown that lung cancer patients from more economically deprived backgrounds are less likely to receive any treatment, surgery or chemotherapy (54). It has been suggested that increased co-morbidities in people in more deprived areas may be related to these differences in treatments or that people from more deprived

backgrounds may be more likely to decline treatment (55). Further work needs to investigate the reasons for these differences in treatment. It is likely some of the factors mentioned here will play a role such as geography and specialisms within hospitals, comorbidities and also patient understanding and choice. It is important that we understand these fully to overcome inequalities in lung cancer treatment which contribute to the inequalities in survival.

It is clear from the data discussed here that there are lung cancer inequalities related to measures of income deprivation in Wales. Those living in more deprived areas experience a greater lung cancer burden and unequal outcomes, and these inequalities relate to smoking. To address lung cancer inequalities, there must be a drive to support smoking cessation and prevention activities in these more economically deprived areas. It is important to support these groups as they face more barriers to cessation whilst discouraging the stigma that lung cancer is a 'self-inflicted smokers' disease'. Therefore, targeted stop smoking campaigns and cessation services are required which reach and meet the needs of more deprived communities and encourage engagement with health services.

In addition to prevention, another important area for improvement is early detection of lung cancer which significantly improves patient outcomes. To this end, the introduction of targeted screening campaigns is recommended which initially focus on recruiting smokers and former smokers from more deprived areas as they experience a greater risk of lung cancer. This is discussed further in Section 7.

Recommendations

- Targeted stop smoking campaigns and smoking cessation services which meet the needs of and engage with more deprived groups.
- Introduce lung screening programmes – initially targeted at more deprived smokers and former smokers who are at greater lung cancer risk.

4. Geographical lung cancer inequalities

In addition to lung cancer inequalities directly linked to measures of relative income deprivation in Wales, there are also geographical health inequalities and specifically lung cancer inequalities. These geographical inequalities also relate to deprivation. Relative levels of deprivation within health boards and local authorities can be used as a crude way to relate deprivation with health inequalities within and across areas of Wales. When looking at geography at the level of local health boards in Wales, there are differences in health between different areas, for example between 2010-14 a male born in Hywel Dda UHB would have a life expectancy of 79.2 years, compared to Cwm Taf Morgannwg UHB where the life expectancy would be 2 and a half years lower at 76.6 years (9). Similarly, when looking at the WIMD measure of health, in Cwm Taf Morgannwg UHB 33.8% of LSOAs are in the most deprived fifth in Wales compared to Hywel Dda UHB where only 6.6% of LSOAs are in the most deprived fifth (56). Geographical health inequalities likely do exist at least in part due to deprivation inequalities, although some of this may be mitigated by factors such as the differing activities of health boards and local authorities, although an analysis of this will not form part of this discussion.

In this section geographical inequalities will be explored. Firstly, in terms of smoking rates as this is likely to be an important driver in lung cancer inequalities and then geographical lung cancer inequalities will be examined in terms of incidence, staging, mortality and wait times. When investigating geographical smoking and lung cancer inequalities, looking at the health board level does not give a full picture of the inequalities that exist between regions. Health boards often cover large areas with a wide range of living circumstances. Therefore, where possible data has also been presented at a local authority level to give a clearer picture of the geographical inequalities that exist across Wales and within the same health board, Aneurin Bevan UHB will be used as a case study for the latter. The scope of this section does not include an analysis of the performance of or facilities within health boards or local authorities or their funding and how this may impact lung cancer outcomes. Instead, the focus of this section is to highlight geographical lung cancer inequalities and discuss their relation to geographical smoking differences and explore their potential relationship with relative deprivation measures within those areas. Powys THB has been excluded from analysis due to a lack of cancer treatment facilities resulting in patients being treated in alternative health boards.

Smoking

Smoking is the biggest risk factor for lung cancer and as this report examines smoking and its inequalities as a driver of lung cancer inequalities, we will first look at the geographical differences in smoking rates. Smoking rates across geographical areas also likely relate to relative deprivation levels because as discussed previously in section 2 smoking rates have many links to different deprivation measures.

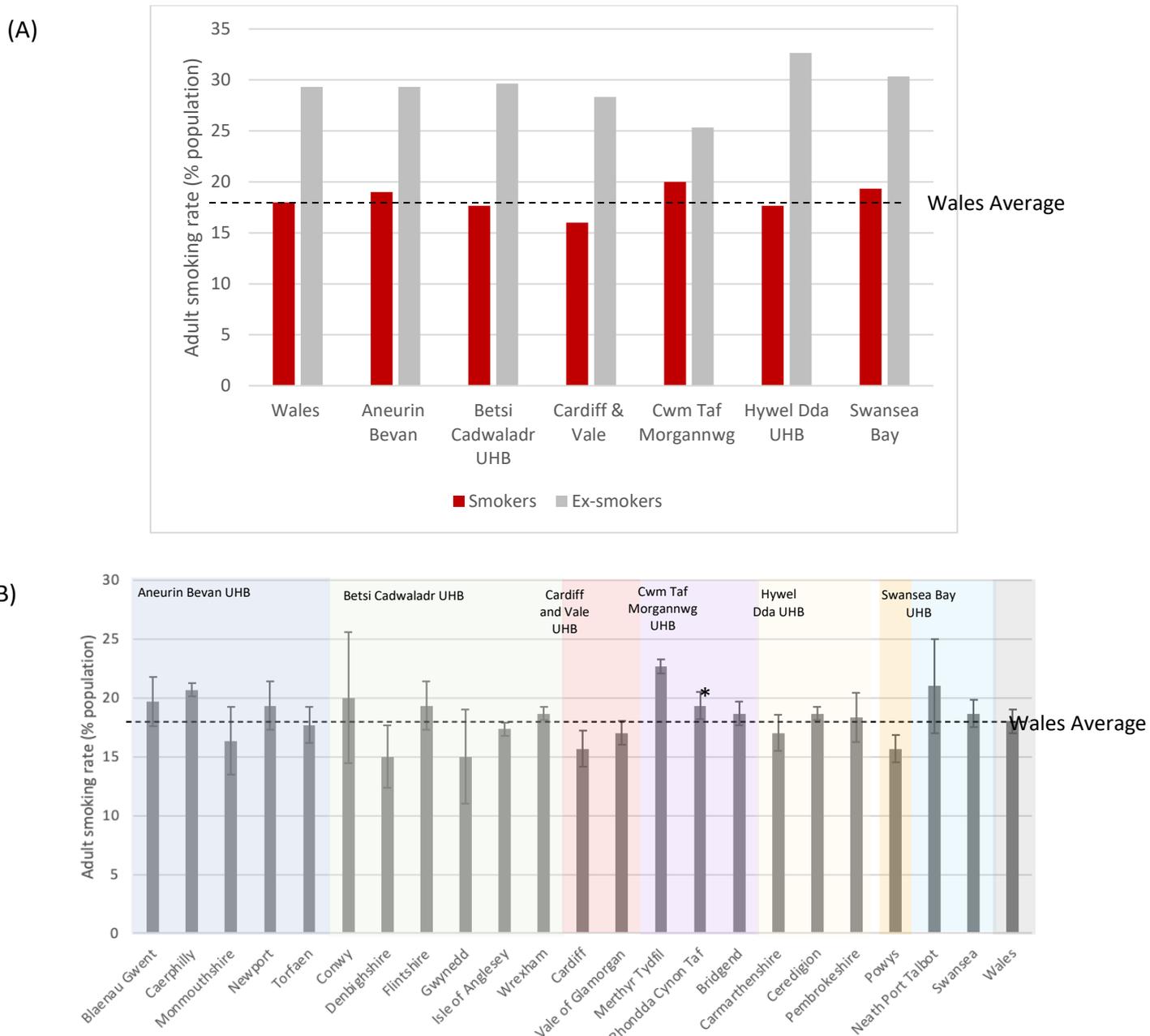


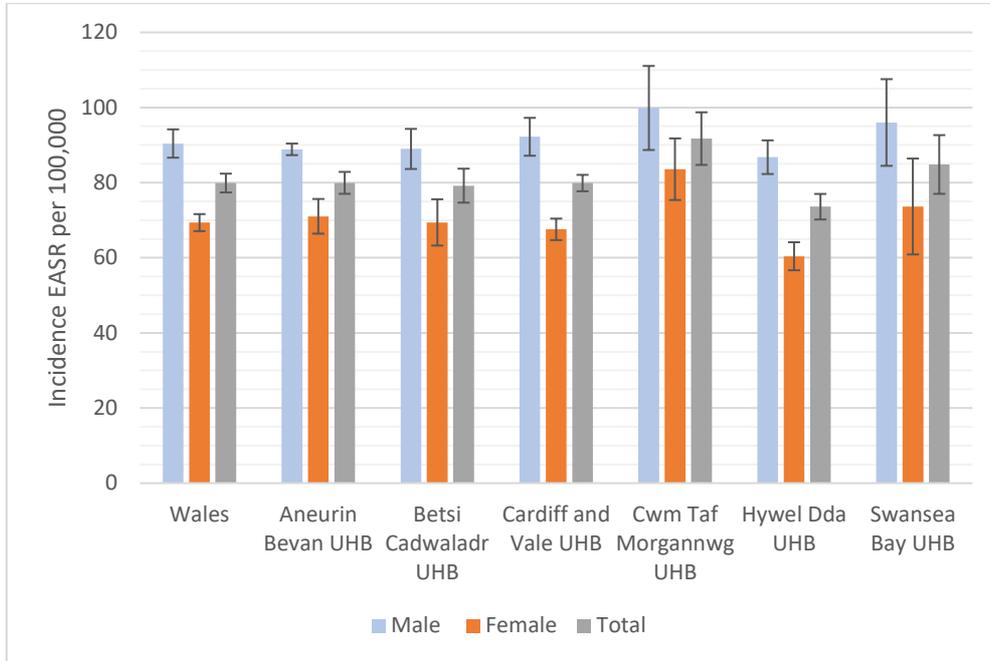
Figure 5. Average smoking rates (A) Local Health Boards (B) Local authorities in Wales, 2016-17/2019-20. StatsWales Data (57).

There are geographical differences in smoking rates across Wales both at a health board and local authority level. Figure 5A shows that when looking at health board level, the highest smoking rates are in Cwm Taf Morgannwg UHB (20%), which is 2% higher than the Wales average and 4% higher than Cardiff and Vale UHB which has the lowest rates (16%). Although in general the smoking rates have decreased over the last few years across all health boards in Wales, there are still trends for some health boards such as Cwm Taf Morgannwg to remain above the Wales average smoking rates. As shown in figure 5B when looking at local authority level there are differences in smoking rates between areas, and some of these local authorities experience similarly persistent higher smoking rates such as Merthyr Tydfil. Figure 5B shows there are also differences between local authorities within the same health board. For example, in Aneurin Bevan UHB smoking rates are above average for Wales in Blaenau Gwent, Caerphilly and Newport and then lower than Wales in

Monmouthshire and Newport. Looking at this more granular level allows identification of areas where greater focus on smoking cessation needs to be placed to reduce these inequalities.

Lung cancer incidence

(A)



(B)

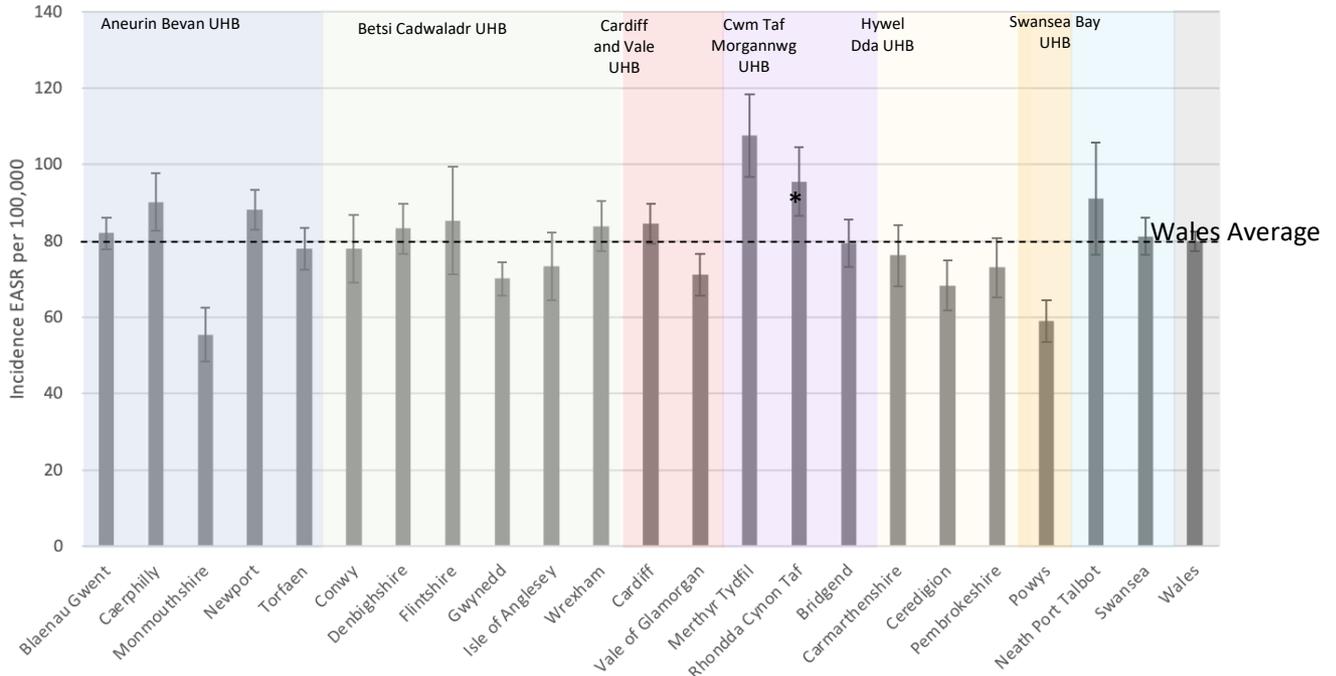


Figure 6. Average European Age Standardised Rates for lung cancer incidence across (A) Local Health Boards (B) Local Authorities in Wales 2014-2018. Error bars = standard deviation. WCISU Data (13).

As figure 6 shows, the rates of lung cancer incidence per 100,000 show variation across health boards and local authorities. As shown in figure 6A, incidence rates for both males

and females are highest in Cwm Taf Morgannwg UHB. The average total rates are significantly higher in Cwm Taf Morgannwg UHB (91.7 per 100,000) compared to Hywel Dda UHB, where the lowest rates are observed (73.6 per 100,000). The same patterns of lung cancer incidence are observed for males and females with incidence rates being similar across Aneurin Bevan UHB, Betsi Cadwaladr UHB and Cardiff and Vale UHB and then a trend for lower rates in Hywel Dda UHB and higher rates in Cwm Taf Morgannwg UHB and Swansea Bay UHB.

As shown in figure 6B, when looking at a lower level at local authorities, geographical inequalities are much more apparent within some health boards. For example, Aneurin Bevan UHB where three local authorities, Blaenau Gwent, Caerphilly and Newport have higher average lung cancer incidence rates than the average for Wales whilst Monmouthshire has the lowest incidence rates in Wales. When looking at the differences in lung cancer incidence rates they broadly match differences in smoking rates; the highest average lung cancer rates are found in Merthyr Tydfil and this is matched by the highest average smoking rates. This demonstrates the role smoking inequalities has in driving geographical lung cancer inequalities. This pattern is not exact and in some health boards and local authorities the data does not match perfectly, highlighting that there may also be other factors involved for example in Cardiff smoking rates are lower than average, but this is not reflected in lung cancer incidence, in this case other risk factors such as air pollution may play an important role.

Stage at diagnosis

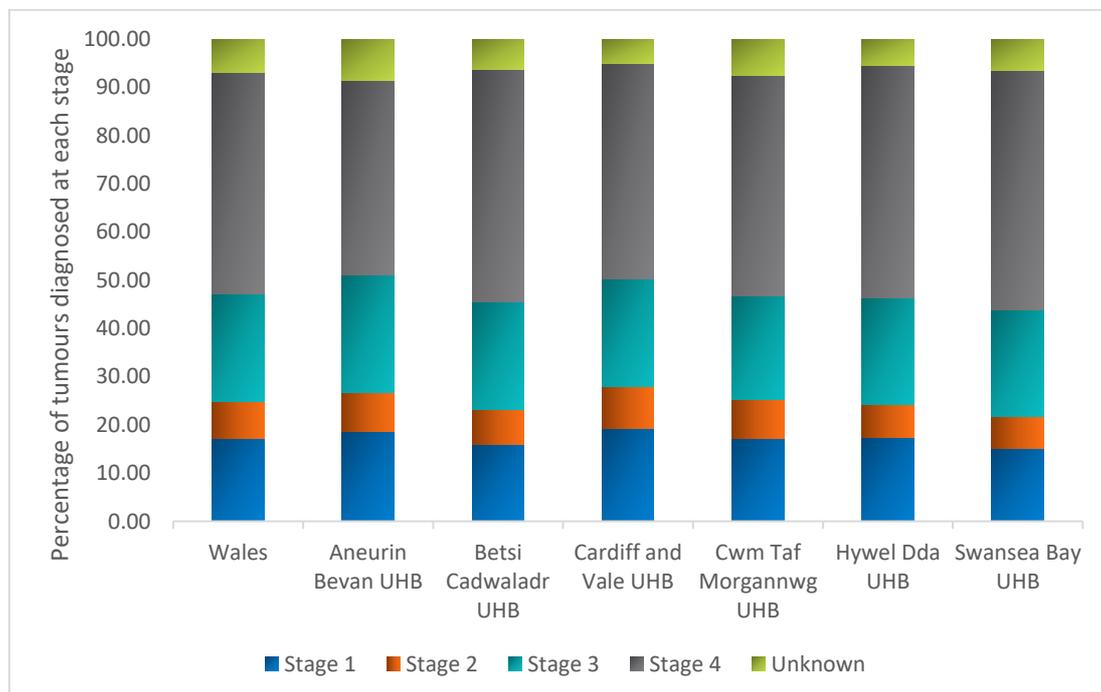


Figure 7. Proportion of lung cancers diagnosed at each stage (1-4 and unknown) for each local health board 2016-2018. WCISU Data (13).

In addition to differences in lung cancer incidence rates across local health boards in Wales there are also small differences in the proportion of tumours diagnosed at different stages. This is important because stage at diagnosis directly influences prognosis and the majority of lung cancers in Wales are diagnosed at an advanced stage (3 or 4). As shown in figure

7, some health boards tend to have a higher proportion of tumours diagnosed at stage 4, such as Swansea Bay UHB (49.6%). This is compared to Aneurin Bevan UHB which has the lowest proportion of stage 4 tumours (40.5%). This could in part be due to a lower proportion of diagnoses due to emergency presentation in Aneurin Bevan UHB compared to some other health boards (Freedom of information request, see appendix 1). Conversely only a relatively small proportion of lung cancers are diagnosed at an early stage in Wales (stage 1 - 17.2%). As figure 7 shows, there are also small differences in stage 1 diagnosis across health boards, Cardiff and Vale UHB have the highest proportion (19.2%) compared to the lowest in Swansea Bay UHB (15.1%). There is a clear need to improve the proportion of lung cancers which are diagnosed at an early stage across Wales which would likely improve lung cancer outcomes due to better curative treatment options in early-stage tumours (58). This data could help establish which health boards need an even greater focus on targeted interventions to improve earlier diagnosis. Such as symptom awareness campaigns and importantly lung health checks and screening.

Average 1-year survival in Wales just under 40% for females and around 33.5% for males between 2014-18 (51). These numbers become even lower when looking at longer term survival with average 5-year survival rates of 16.8% for females and 12.7% for males during the same period (51). The figures are similarly low across all health boards with only relatively small differences. The poor survival is likely due to high proportions of lung cancers being diagnosed at late stages across all health boards. This is something which needs to be improved to improve lung cancer patient outcomes and again highlights the need for a focus on earlier diagnosis when there are more curative treatment options (58). Lung cancer screening can help detect tumours at an earlier stage which will lead to improved survival.

Wait times

The single cancer pathway introduced in June 2019 changed the way that cancer wait time data was reported in Wales (18). Cancer wait time is classified as the time between the point at which cancer is suspected and the time at which patients begin their first definitive treatment. For all cancer patients, regardless of their route to diagnosis, the target cancer wait time is less than 62 days. The aim of introducing this measure was to not only improve reporting on wait times but to act as a catalyst for change to improve services and identify bottlenecks (18). (Reporting against this target stopped in 2020 during the pandemic to ease pressure on the NHS (18).

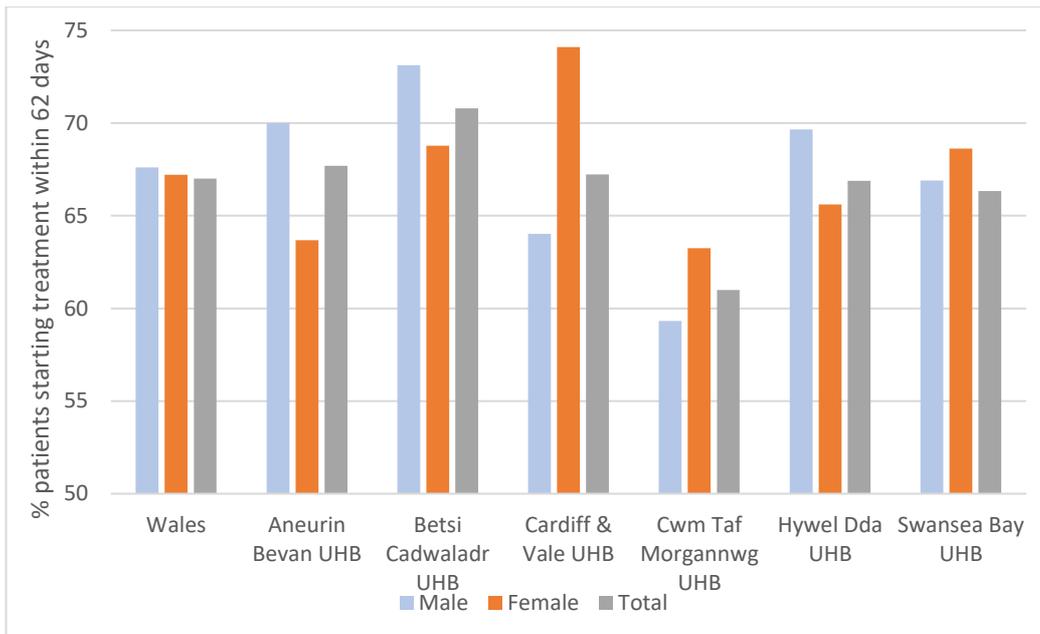


Figure 8. Percentage of patients starting their first definitive treatment for lung cancer within 62 days from the point of cancer suspicion across local health boards – 2021. StatsWales Data (20).

Figure 8 shows that there are not only geographical differences in lung cancer incidence across health boards, but that there are also differences in patient experience within the healthcare system with varying proportions of lung cancer patients starting their first treatment within the 62-day target across health boards. The highest proportion of patients starting treatment within the target wait time is within Betsi Cadwaladr UHB (70.8%) and the lowest is in Cwm Taf Morgannwg UHB (61%). The data also shows differences between male and female wait times within health boards, though not within Wales as a whole, which warrants further investigation. It is also worth noting that there are considerable fluctuations in the proportion of patients starting treatment within this target time for each health board across different months. Compliance with the wait time target is higher for lung cancer across all health boards compared to all cancers, which may reflect the fact that lung cancer tends to be diagnosed at a later stage and more frequently through emergency presentation compared to other cancers (13) (46). A detailed investigation into why these differences exist across health boards is beyond the scope of this report but it may be due to differences in diagnostic or treatment capacity and waiting lists, further investigation is needed to establish the cause of these differences and where improvements can be made especially in those health boards such as Cwm Taf Morgannwg UHB which have lower rates of compliance with the target wait time.

Lung cancer mortality

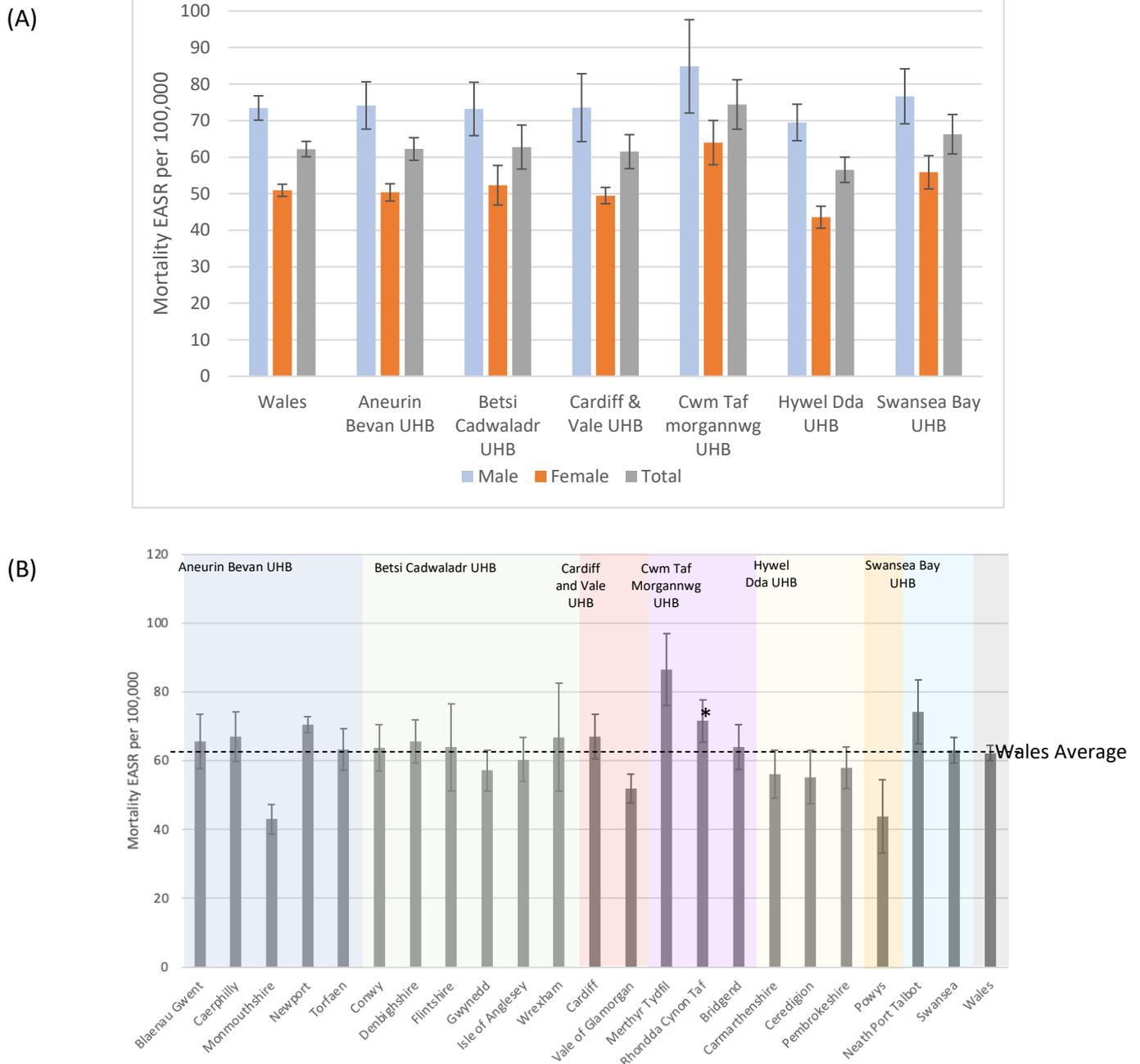


Figure 9. Average European Age Standardised Rates for lung cancer mortality across (A) Local Health Boards (B) Local Authorities 2013-2017. Error bars = standard deviation. WCISU Data (50).

Lung cancer mortality rates show similar geographical differences to lung cancer incidence rates at both a health board and local authority level. As figure 9A shows, there is a trend for highest average total mortality rates in Cwm Taf Morgannwg UHB (74.4 per 100,000) and lowest average total rates in Hywel Dda UHB (56.5 per 100,000). Similarly, when looking at local authorities the same geographical inequalities are observed as for lung cancer incidence. For example, figure 9B shows that, within Aneurin Bevan UHB, Monmouthshire has considerably lower lung cancer mortality rates than the other local authorities. As with lung cancer incidence these differences in mortality both across health boards and local

authorities follow a similar pattern to differences in smoking rates. This demonstrates a need for targeted smoking cessation in the areas worst affected and that to fully understand the geographical inequalities it is important to look deeper at the local authority level to understand inequalities that exist within health boards.

Aneurin Bevan UHB case study

This section has highlighted the existence of lung cancer inequalities across Wales at both a health board and local authority level which is matched by similar smoking inequalities. Where possible it is useful to look at data at a local authority level to understand the geographical lung cancer and smoking inequalities that exist across Wales and understand geographical inequalities within health boards. Here Aneurin Bevan UHB will be used as a case study to explore the relationship between smoking rates as a driver of differences in lung cancer incidence across local authorities within this health board and how these smoking rates may relate to different measures of deprivation. Aneurin Bevan UHB was chosen as the case study as this was the health board which showed the largest differences in lung cancer incidence between local authorities.

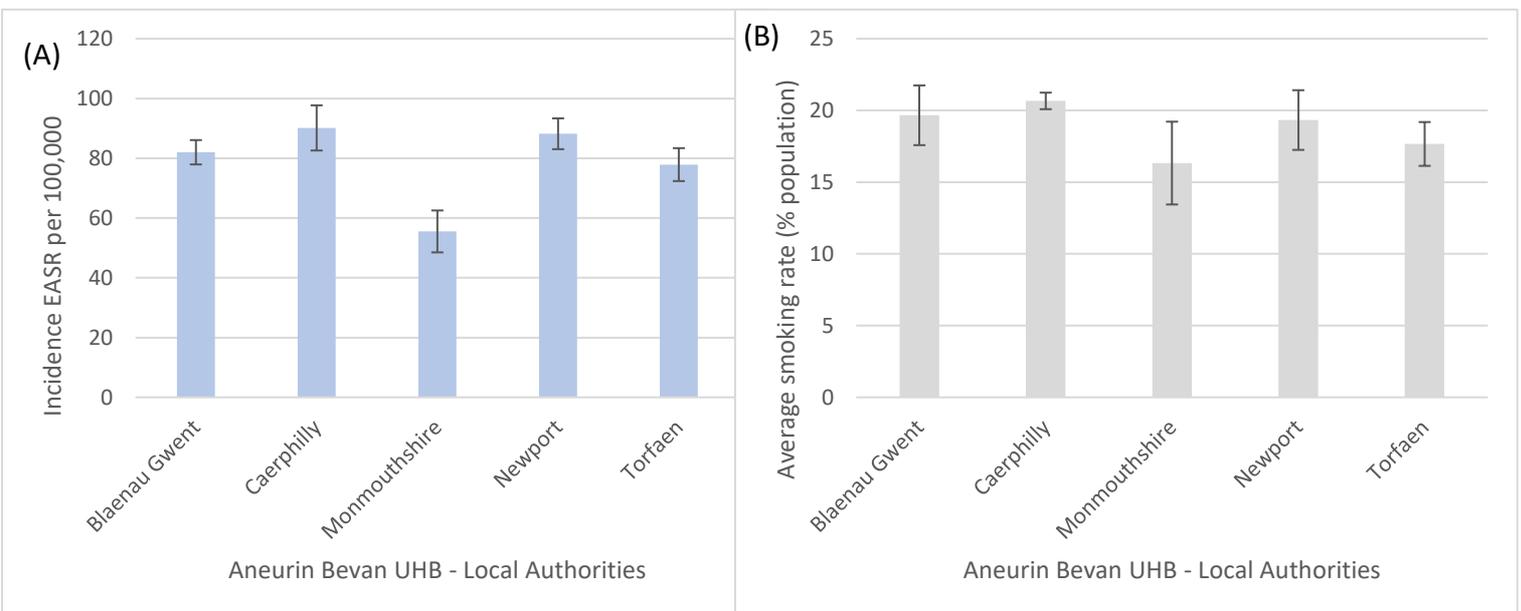


Figure 10. (A) Average European Age Standardised Rates for lung cancer incidence across Aneurin Bevan local authorities 2014-2018. WCISU Data (13). (B) Average smoking rates across local health boards in Wales 2016-17/2019-20. StatsWales Data (57).

As shown in figure 10A, the highest average lung cancer incidence rates in Aneurin Bevan UHB are observed in Caerphilly and Newport, (90.2 and 88.2 per 100,000 people respectively) which are significantly higher than the average rates in Monmouthshire, (55.5 per 100,000 people). The rates also tend to be higher in Blaenau Gwent and to a slightly lesser extent Torfaen. As shown in figure 10B, the smoking rates across these local authorities show a similar pattern with a trend for Monmouthshire to have lower average smoking rates than the other local authorities within the health board. Similarly,

geographical inequalities in terms of relative deprivation levels exist across all WMID domains within Aneurin Bevan UHB as shown in Table 1 below.

Area	Overall	Income	Employment	Health	Education	Access to services	Housing	Community safety	Physical environment
Aneurin Bevan UHB	10% - 11.7% 20% - 27.2% 50% - 57.3%	10% - 10.9% 20% - 24.7% 50% - 58.4%	10% - 10.3% 20% - 25.3% 50% - 59%	10% - 10.9% 20% - 24.2% 50% - 60.1%	10% - 13.6% 20% - 25.8% 50% - 57.1%	10% - 4.9% 20% - 12.5% 50% - 41.8%	10% - 6% 20% - 17.7% 50% - 45.9%	10% - 19.8% 20% - 35.1% 50% - 70.4%	10% - 14.9% 20% - 30.2% 50% - 69.6%
Caerphilly	10% - 10% 20% - 23.6% 50% - 62.7%	10% - 10% 20% - 24.5% 50% - 64.5%	10% - 11.8% 20% - 29.1% 50% - 68.2%	10% - 10.9% 20% - 24.5% 50% - 70%	10% - 12.7% 20% - 28.2% 50% - 65.5%	10% - 0.9% 20% - 4.5% 50% - 26.4%	10% - 3.6% 20% - 12.7% 50% - 55.5%	10% - 14.5% 20% - 30% 50% - 77.3%	10% - 6.4% 20% - 15.5% 50% - 57.3%
Blaenau Gwent	10% - 12.8% 20% - 44.7% 50% - 85.1%	10% - 10.6% 20% - 36.2% 50% - 80.9%	10% - 23.4% 20% - 48.9% 50% - 91.5%	10% - 19.1% 20% - 36.2% 50% - 87.2%	10% - 17% 20% - 38.3% 50% - 85.1%	10% - 0% 20% - 17% 50% - 51.1%	10% - 10.6% 20% - 27.7% 50% - 61.7%	10% - 27.7 20% - 53.2% 50% - 97.9%	10% - 0% 20% - 8.5% 50% - 48.9%
Torfaen	10% - 5% 20% - 31.7% 50% - 56.7	10% - 8.3% 20% - 23.3% 50% - 60%	10% - 5% 20% - 21.7% 50% - 58.3%	10% - 8.3% 20% - 30% 50% - 66.7%	10% - 13.3% 20% - 28.3% 50% - 60%	10% - 0% 20% - 5% 50% - 38.3%	10% - 0% 20% - 13.3% 50% - 38.3%	10% - 15% 20% - 38.3% 50% - 71.7%	10% - 6.7% 20% - 13.3% 50% - 68.3%
Monmouthshire	10% - 0% 20% - 1.8% 50% - 19.6%	10% - 0% 20% - 3.6% 50% - 26.8%	10% - 0% 20% - 1.8% 50% - 23.2%	10% - 0% 20% - 3.6% 50% - 19.6%	10% - 0% 20% - 1.8% 50% - 21.4%	10% - 26.8% 20% - 39.3% 50% - 66.1	10% - 1.8% 20% - 10.7% 50% - 35.7%	10% - 1.8% 20% - 5.4% 50% - 23.2%	10% - 5.4% 20% - 30.4% 50% - 67.9%
Newport	10% - 24.2% 20% - 34.7% 50% - 60%	10% - 20% 20% - 32.6% 50% - 57.9%	10% - 11.6% 20% - 25.3% 50% - 53.7%	10% - 14.7% 20% - 26.3% 50% - 54.7%	10% - 21.1% 20% - 29.5% 50% - 52.6%	10% - 2.1% 20% - 8.4% 50% - 43.2%	10% - 12.6% 20% - 25.3% 50% - 37.9%	10% - 35.8% 20% - 47.4% 50% - 75.8%	10% - 43.2% 20% - 68.4% 50% - 95.8%

Table 1. % LSOAs in each local authority within Aneurin Bevan UHB that fall within the 10%, 20% and 50% most deprived areas in Wales for each WMID domain. WIMD Data (56).

The relationship between different domains of the WMID and smoking rates were explored in detail in section 2, here the relative levels of deprivation across different domains within Aneurin Bevan UHB local authorities are explored in terms of their correlation with smoking rates and lung cancer incidence. There are differences in the overall WMID relative deprivation levels across the local authorities within this health board, as shown in table 1. The local authority with the highest proportion of LSOAs within the most deprived fifth in Wales is Blaenau Gwent (44.7%), followed by Newport (34.7%), Torfaen (31.7%), Caerphilly (23.6%) and then the Monmouthshire has the lowest proportion (1.8%). This correlates generally with Monmouthshire having lower average smoking rates than the other four local authorities. This pattern is not exact but broadly higher relative overall deprivation rates correlate with higher smoking rates.

Differences in relative deprivation in domains traditionally linked to increased smoking, namely income and employment, correlate with the smoking and lung cancer inequalities within local authorities within Aneurin Bevan UHB. All other local authorities have a considerably higher proportion of LSOAs in the most deprived fifth for both of these domains compared to Monmouthshire. Additionally, differences in the relative levels of deprivation within the health and education domains also correlate with smoking inequalities across these local authorities. There are considerably higher proportions of LSOAs in the most deprived fifth in Blaenau Gwent, Caerphilly, Torfaen and Newport compared to Monmouthshire which has low levels of deprivation within these domains. Both health and education were identified as domains which should be given more consideration in terms of the links between smoking, deprivation and lung cancer.

The housing and community safety domains were identified as likely to only have a modest effect on smoking rates. The relative levels of deprivation within these domains also correlate less clearly with the smoking inequalities across local authorities. In the community

safety domain, Monmouthshire has a considerably lower proportion of LSOAs within the most deprived fifth compared to all the other local authorities within Aneurin Bevan UHB. This may have some links to smoking rates although the effects are likely to be small. Although Monmouthshire also has the lowest proportion of LSOAs within the most deprived fifth within the housing domain, the differences in relative deprivation levels between the local authorities are less in this domain compared to others. These two domains may have some links to smoking rates and lung cancer incidence, but this is likely to be small and not as important as other domains.

In contrast to other WMID deprivation domains, Monmouthshire has a higher proportion of LSOAs within the most deprived fifth in the access to services domain. As discussed in section 2, this domain may affect smoking rates in two ways. Firstly, a lack of access to services deprivation may relate to higher smoking rates in the other local authorities due to greater access to tobacco products. On the other hand, greater access to services deprivation may affect the access to smoking cessation services smokers have within that local authority.

The physical environment deprivation domain is likely to relate to lung cancer inequalities independently of smoking rates as air pollution is a lung cancer risk factor itself (CRUK air pollution). There are geographical inequalities in terms of physical environment deprivation across local authorities within Aneurin Bevan UHB. Newport has the highest proportion of LSOAs within the most deprived fifth (68.4%) compared to the lowest in Blaenau Gwent (8.5%). This domain should be considered independently from smoking rates and may drive some of the geographical inequalities in lung cancer incidence although its effect will be lower than smoking.

This case study has highlighted the geographical inequalities in smoking and lung cancer that exist across local authorities within the same health board and how these may relate to inequalities in relative deprivation levels. It has emphasised the need to look at lower geographical levels to understand the inequalities in greater detail and identify regions which would benefit from targeted action through improved smoking cessation services and lung cancer screening. This case study also once again brought into focus the requirement to look beyond income deprivation when exploring the links between smoking, deprivation and lung cancer, with other domains such as health and education likely to be important contributing factors.

Recommendations

1. There should be a general focus in Wales on lung cancer prevention (smoking cessation services) and earlier detection (lung screening and awareness campaigns) – with a need for the most resources to be targeted in more deprived areas with greater smoking rates and lung cancer burden.
2. When looking at geographical lung cancer inequalities it is better to focus at the local authority level and more statistics should be reported at this level where possible.
3. Other WMID deprivation domains than income should be considered when looking at lung cancer and smoking inequalities.

5. Lung cancer inequalities – Sex

Lung cancer inequalities exist between males and females when looking at multiple measures of the disease – namely incidence, mortality, tumour stage and survival – with men having worse outcomes across the board. Typically, these differences have been attributed to differences in smoking behaviour (59) (60) and help seeking behaviour (61) both of which contribute, however it is becoming increasingly clear that this relationship is more complex.

Smoking inequalities

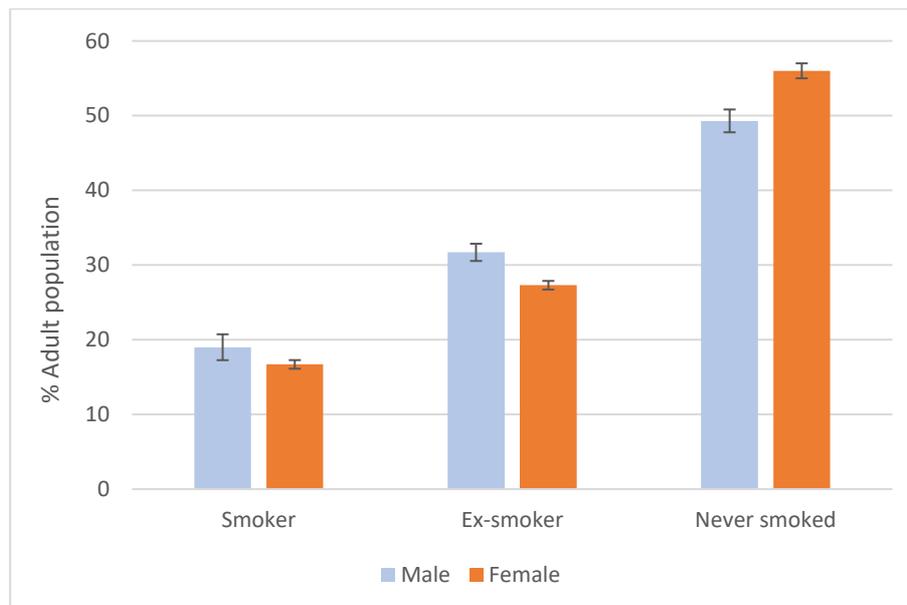


Figure 11. Average smoking status in Wales 2017-18/2019-20. StatsWales Data (62).

As shown in figure 11, smoking rates between males and females show inequalities with more males identifying as either current smokers or ex-smokers (19% and 31.7% for males vs 16.7% and 27.3% for females), both of which put individuals at an increased risk of lung cancer (63). These differences in smoking rates are likely to be a big factor in explaining the differences in lung cancer incidence and mortality between males and females.

Although generally male smoking rates are higher than female, this is not true in all cases when looking at a comparison of age and sex breakdown across local health boards. In some health boards females tend to have higher smoking rates than males in particular age groups. For example, in Cwm Taf Morgannwg UHB 2019/20 the average smoking rate was the same overall between males and females but when looking at the age ranges of 45-64 and 64+ females had slightly higher rates (1-2% difference) (Freedom of information request, see appendix 2). This shows that when considering targeting smoking cessation services, it would be beneficial to look in more detail at the smoking demographic within health boards as this is likely to show some variation between them and therefore may require different approaches.

Additionally, the differences between male and female smoking behaviours have changed over time (64). The gap in smoking rates between males and females has narrowed over time (64). Pack history is a way to measure how much individuals have smoked over a large

period of time and is calculated by multiplying the number of packs of cigarettes smoker per day by the number of years a person has smoked (65). Similarly to smoking rates, differences between males and females in terms of pack history have also decreased and there is no longer a difference in the age at which individuals begin smoking between males and females (64).

Further to this, some evidence has led to the suggestion that smoking differentially effects males and females, with females more susceptible to the ill-effects of tobacco (66) (67) (68). This is potentially due to biological, hormonal or genetic differences as females have been shown to be at a greater risk of lung cancer with a lower pack history than males, although the evidence is variable (66) (67) (68). Females are also more likely to develop lung cancer as non-smokers (67). Therefore, as more evidence emerges it may be beneficial to pay more attention to the differences between males and females in terms of lung cancer risk and consider this in targeted policies. For example, it has been suggested that it may be beneficial to women if the lung cancer screening eligibility guidelines changed to a lower age and pack history threshold (69).

Incidence and mortality

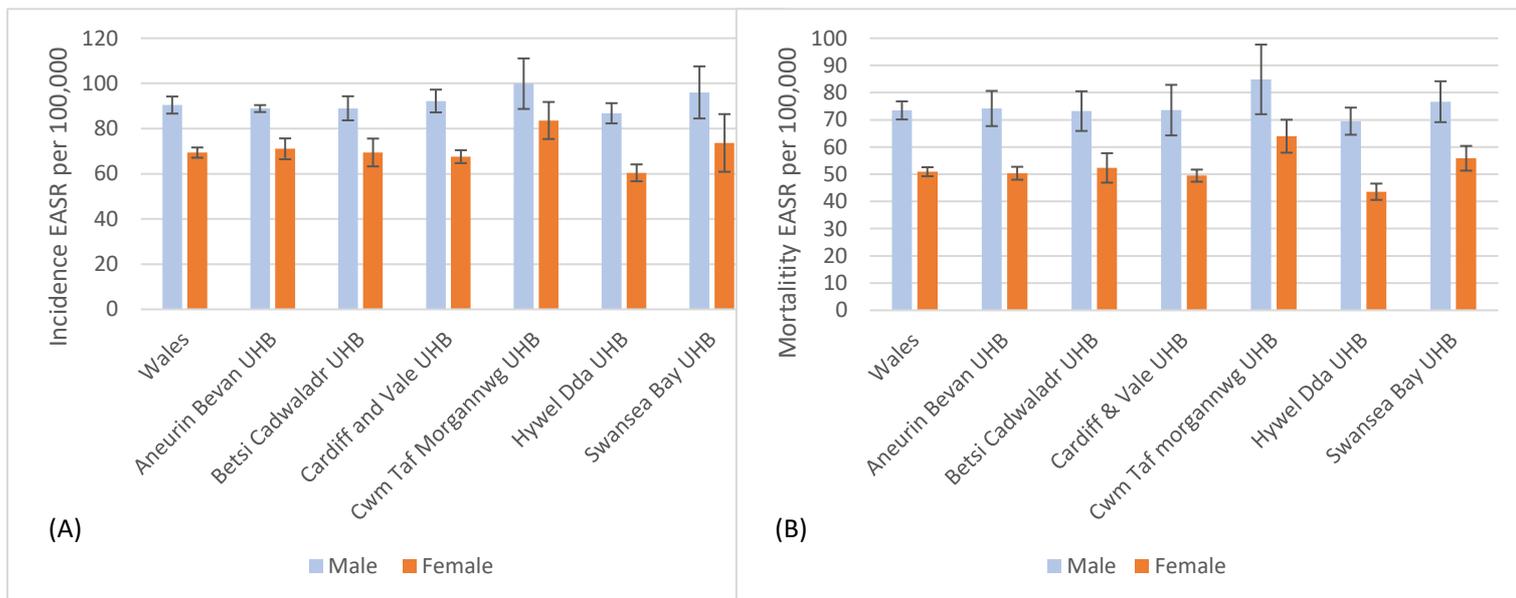


Figure 12. (A) Average European Age Standardised Rates of lung cancer incidence in males and females across local health boards 2014-2018. (B) Average European Age Standardised Rates of lung cancer mortality in males and females across local health boards 2013-2017. Error bars = standard deviation. WCISU Data (13) (50).

As shown in figure 12A, in Wales the average lung cancer incidence rates are higher in males than females and this is true across all health boards. As figure 12B shows, this is matched by the same pattern of inequalities between males and females across Wales and individual health boards when looking at lung cancer mortality rates. Higher incidence/mortality in males is generally attributed to differences in smoking rates between males and females (60).

Survival

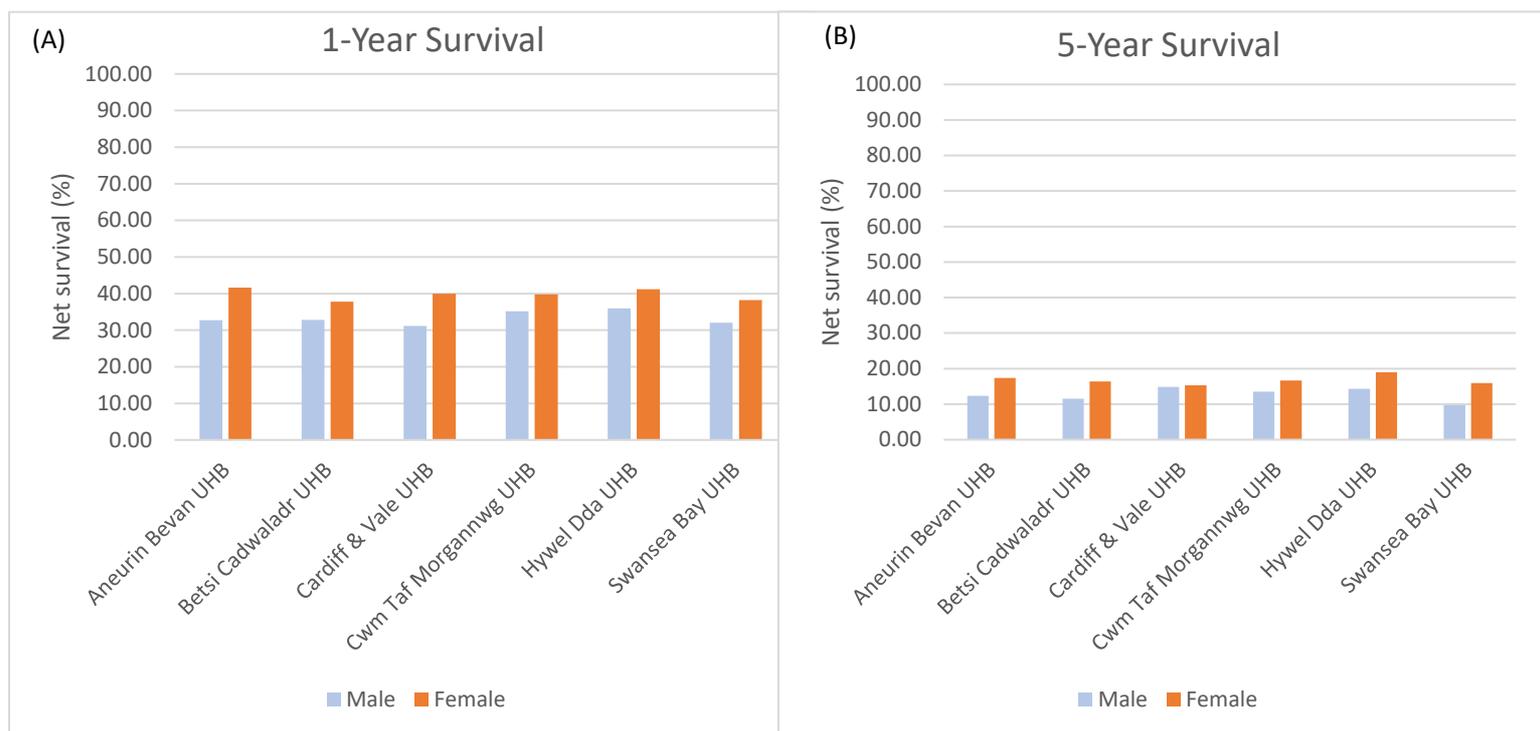


Figure 13. (A) Net 1-year lung cancer survival percentage. (B) Net 5-year lung cancer survival percentage. 2014-2018 WCISU Data (51).

In addition to higher rates of lung cancer incidence and mortality, males also have worse survival rates than females. It is clear that the survival rates in general are very poor for lung cancer but within this, inequalities exist based on sex. As shown in figure 13A, males have an average 1-year survival rate nearly 6.5% lower than females and as shown in figure 13B, at 5-years this drops to a 4% lower average survival rate. This same pattern of survival differences is observed across all health boards in Wales. This pattern of lower male lung cancer survival is not unique to Wales, and it has been reported in several research articles that males have lower survival and worse prognosis across different tumour stages (67). This is not thought to be as a result of different therapeutic options used, but men have been demonstrated to have lower survival across a range of treatment options (67).

Tumour stage at diagnosis

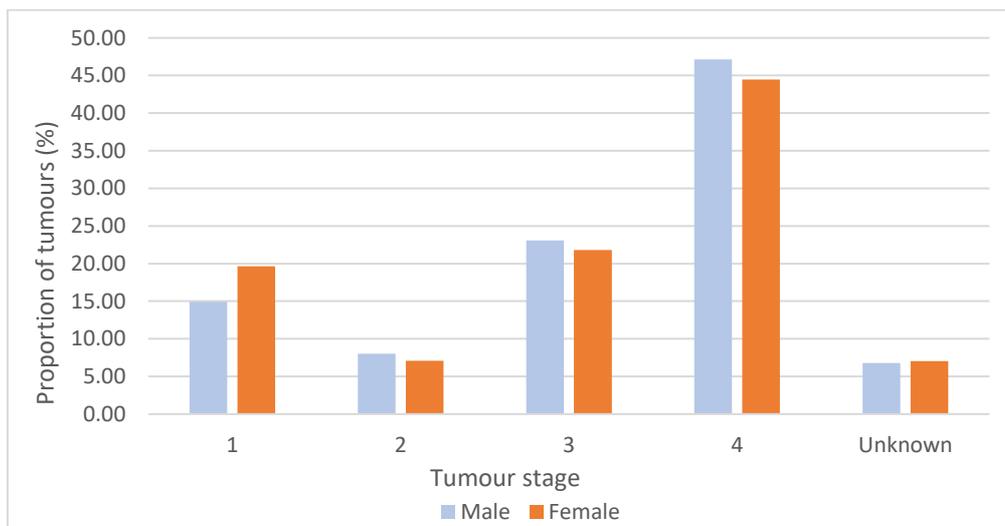


Figure 14. Proportion of lung cancers diagnosed at each stage in males and females across Wales 2016-18. WCISU Data (13).

There are also inequalities in the proportion of tumours diagnosed at each stage between males and females. As shown in figure 14, females have a slightly higher proportion of tumours diagnosed at stage 1 (19.6 % vs 15%), where there are curative treatment options and improved chances of survival. Males have a slightly higher proportion of tumours diagnosed at an advanced stage, 3 or 4 (70.3% vs 66.3%) where survival outcomes are less favourable. This trend for a higher proportion of tumours diagnosed at an early stage has been observed in other countries such as the USA (66). These differences may go some way to explaining the differences in survival rates between males and females, although it has been shown males have lower survival across all stages (67).

This data highlights that in general there is a need for a higher proportion of lung cancers to be diagnosed at an earlier stage but that a focus may need to be placed on targeting men to address these inequalities. There are several potential reasons why the proportion of tumours diagnosed in males at stage 1 is lower than females and stage 4 is higher, such as barriers to help seeking behaviour.

Traditionally, men are seen as less likely to engage with the healthcare system and present to the GP with symptoms (61). Compared to women who are seen as more likely to engage with GPs and be more familiar with the healthcare setting throughout their life (61). However, emerging research is showing that this relationship between sex and help seeking behaviour may actually be more complex than this, with similar barriers and attitudes expressed between males and females (61). This is an area that warrants further research to understand the similarities and differences in attitudes and barriers to lung cancer symptom presentation in males and females.

However, there is some evidence to suggest that men may be less aware of lung cancer symptoms than women in the UK (70). A literature review highlighted that a barrier to help-seeking behaviour may be lower awareness of lung cancer symptoms, which is more prevalent in men, and identified family members' and female partners' influence in addition to family experience with cancer and health campaigns as facilitators to help seeking behaviour (70).

This section has highlighted that lung cancer inequalities exist according to sex, with men having higher lung cancer incidence and mortality along with lower survival and a higher proportion of tumours diagnosed at stage 4. Smoking has a large part to play in these inequalities as smoking rates are slightly higher in men in Wales. However, other factors may also have a part in causing these inequalities such as potentially lower symptom awareness in men and barriers to help seeking behaviour.

Women may also experience lung cancer inequalities. They may be more susceptible to lung cancer with a lower smoking pack history and more likely to develop lung cancer as a never-smoker. Additionally, the pattern of incidence may change over the coming years due to the decreased gap between male and female smoking rates. Women may also experience many of the same attitudes and barriers to help seeking behaviour with lung cancer symptoms, an area which merits further investigation.

It is of interest that the pattern of smoking between the sexes is not the same across all age groups within health boards. In some health boards female smoking rates are higher than male within some age groups, which is something to consider in terms of targeted smoking cessation campaigns. Overall differences in sex are an important consideration for targeted policies in relation to lung cancer risk. Men and women may face different lung cancer risk as smokers or never smokers and different barriers to help seeking and cessation. It is important to understand these differences to tailor smoking cessation services and lung cancer screening.

Recommendations

- Introduction of targeted symptom awareness campaigns with a focus on males and encouraging help seeking behaviour.
- Differences in lung cancer risk between males and females should be considered and reflected in lung cancer screening guidelines. Guidelines should remain in line with emerging evidence on differences in risk and the threshold for pack history eligibility may need to be lowered to include more at-risk women in screening.
- Targeted cessation should be introduced that considers the smoking demographic within health boards and local authorities, with a particular focus on differences by sex.

6. Smoking Cessation

One of the best ways to address lung cancer inequalities in Wales is to tackle inequalities in smoking rates. Although overall the rates of smoking in Wales are declining, higher smoking rates in the most deprived areas persist and account for a large proportion of health inequalities and in particular lung cancer inequalities. Prevention is one of the best strategies to tackle the problem and this can be achieved in part through targeted smoking cessation programmes in Wales. The positive impact of NHS smoking cessation services in reducing smoking rates in the UK has been shown (71). In England, modelled figures suggest that 15% of the drop in smoking rates between 2001 and 2016 may be attributable to NHS Stop Smoking Services and that cessation attempts using the services are more successful (71). These activities must meet the specific needs of more populations living in more deprived areas and those that have been previously failed by other health campaigns and cessation services.

6 in 10 smokers in Wales stating they want to quit (72). This chapter aims to discuss the current use of smoking cessation services in Wales across local health boards and explore the barriers to smoking cessation that are faced by those living in more deprived areas and offers recommendations on how to engage these populations.

Current use of NHS smoking cessation services in Wales

In Wales all NHS smoking cessation services fall within the single Help Me Quit brand which was rebranded from Stop Smoking Wales in 2019 (73). Help Me Quit offer free smoking cessation support and help people to choose the right services for them within their local area (74). The different cessation services are “Help Me Quit – community”, “Help Me Quit – pharmacy level 3”, “Help Me Quit- hospital services”, “Help Me Quit For Baby”, and additional in-house GP based services (73). Help Me Quit offer support in different formats either in group meetings or one to one support, in person or over the phone (75). Help Me Quit enables free access to nicotine replacement medication and takes place in a variety of settings including community venues, pharmacies and hospitals (75).

Below, data is presented on the current use of the Help Me Quit services across health boards in Wales. The general engagement level of all Help Me Quit services with the smoking population and quit success rate as measured by CO-validation at 4 weeks post-cessation date is presented (Figure 15). CO-validation is where an individual treated by cessation services has their expired carbon monoxide levels measured and they are classed as successfully quitting if the levels are below 10 ppm (73). Data is also shown on which services are utilised per health board (Figure 16) and quit success rate for each service within health boards (Table 2).

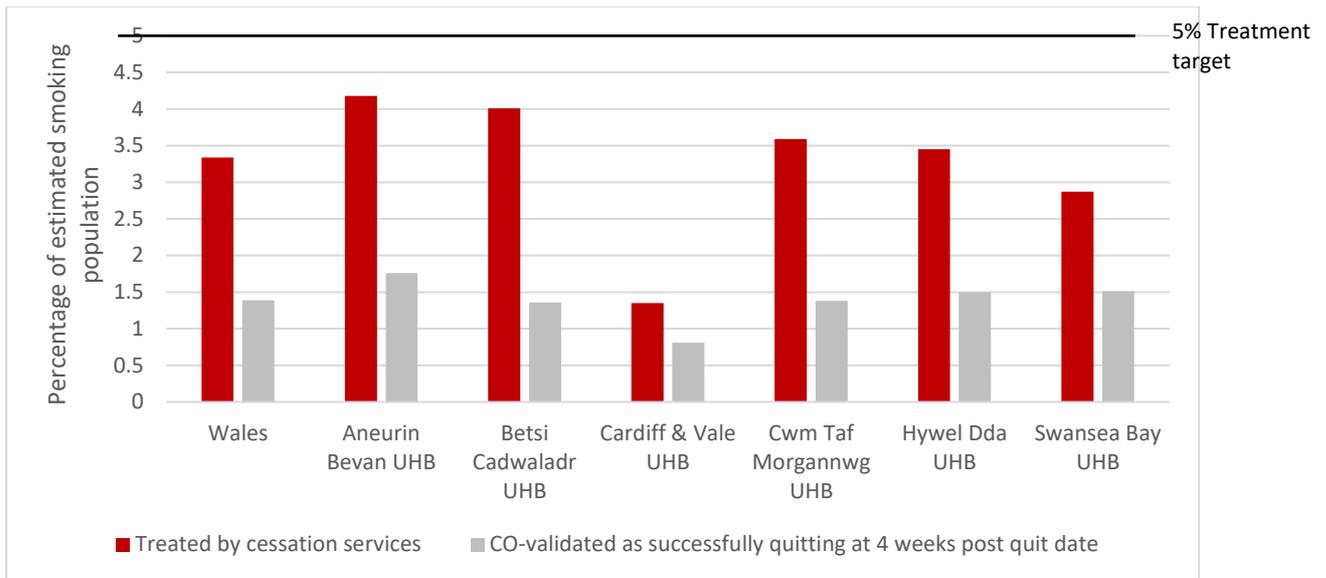


Figure 15. Percentage of the estimated smoking population treated by NHS smoking cessation services across Wales and local health boards compared to the percentage of the smoking population who were CO-validated as successfully quitting 4 weeks post quit date, 2019-2020. StatsWales Data (76).

As shown in figure 15, none of the health boards in Wales hit the target to treat 5% of the smoking population by NHS Help me Quit services in 2019/20. The health boards with the highest proportion of the smoking population treated by cessation services are Aneurin Bevan UHB and Betsi Cadwaladr UHB (4.2% and 4% respectively), and the worst rates are in Cardiff and Vale UHB (1.4%). Similarly, Aneurin Bevan UHB had the highest percentage of the smoking population CO-validated as successfully quitting at 4 weeks post quit date (just under 1.8%) as shown in figure 15. Most health boards have similar rates of smokers CO-validated as successfully quitting (around 1.3-1.5%), compared to the lowest rate in Cardiff and Vale UHB (0.8%).

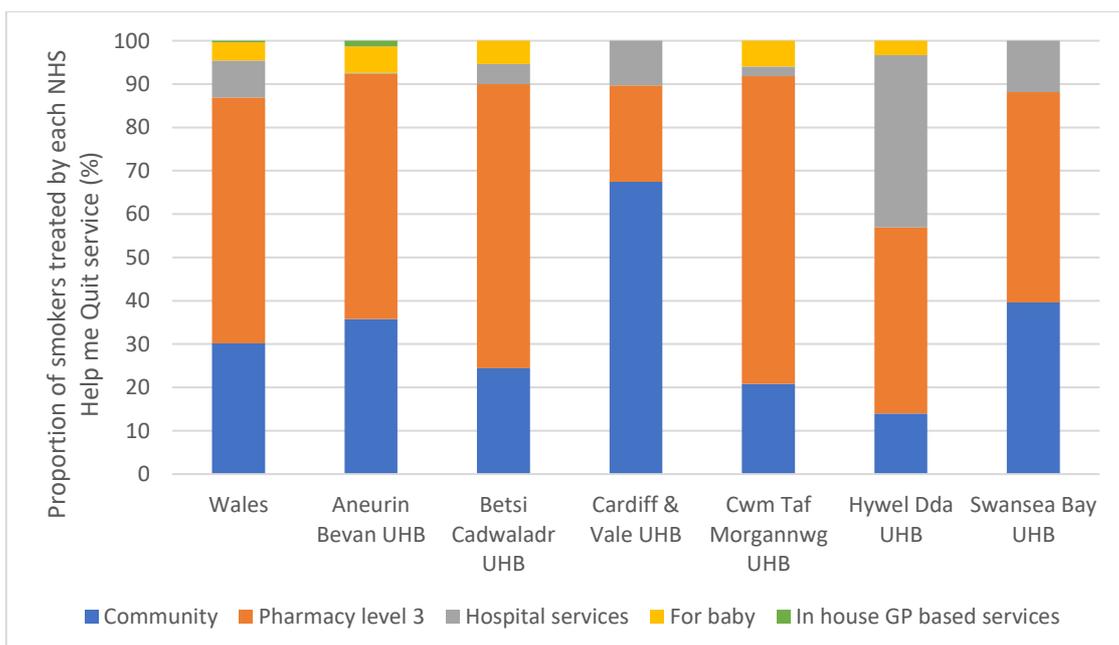


Figure 16. The percentages of people treated by cessation services using each NHS Help Me Quit service in Wales in total and across local health boards, 2019-20. StatsWales Data (76).

As shown in figure 16 above there are differences in the utilisation of different Help Me Quit services across health boards. Across most health boards pharmacy level 3 services are the most widely used cessation services, this is especially true in Cwm Taf Morgannwg UHB and Betsi Cadwaladr UHB. However, in contrast to this in Cardiff and Vale UHB pharmacy level 3 services are much less utilised and community services are by far the most commonly used service. It is also worth noting that in Hywel Dda UHB Hospital services are far more frequently used than in any other health board. Of note, Help Me Quit For Baby is not widely used and in Swansea Bay UHB and Cardiff and Vale UHB nobody was treated via this service in 2019/20. This is an important area for improvement, because in 2018 although the maternal smoking rates in Cardiff were the lowest of the health boards examined in this report, (13.1% at initial appointment) the maternal smoking rates at birth had only dropped slightly (12.5%) (77). In Swansea Bay UHB the maternal smoking rates were higher both at the initial assessment and at birth (18% and 14.2% respectively) although the decrease in smoking rates was greater than in Cardiff and Vale UHB (77). In both health boards this still represents a significant number of mothers smoking during pregnancy. Not only is this an important area to improve engagement within these two health boards but it is important across all health boards. The numbers of expectant mothers engaging is low across all health boards and a significant proportion of mothers still smoke at time of birth (12.5%-19.1%) (77), despite the risks associated with smoking during pregnancy such as increased risk of still births (78). Additionally, only Aneurin Bevan had any smokers treated via in-house GP services and even then, this only made up a very small fraction of the total smokers treated by cessation services.

Health board	Help Me Quit - community	Help Me Quit - pharmacy level 3	Help me Quit - hospital services	Help me Quit for baby	In house GP based services	All services
Aneurin Bevan UHB	48.7	39	0	33.6	40.4	42.1
Betsi Cadwaladr UHB	37.2	32.3	47.9	25.8	0	33.9
Cardiff & Vale UHB	50.4	84.1	69.8	0	0	59.9
Cwm Taf Morgannwg UHB	38.9	39	36.8	30.5	0	38.4
Hywel Dda UHB	42	41	47.8	30.2	0	43.5
Swansea Bay UHB	44.9	61.4	42.5	0	0	52.6
Wales	44.2	40.3	47.8	30	40.4	41.7

Table 2. The percentage of treated people CO-validated as successfully quitting at 4 weeks post quit date per NHS Help Me Quit service broken down by health board, 2019/20. StatsWales Data (76).

In Wales, the cessation success rate, measured as the proportion of smokers CO-validated as successfully quitting 4 weeks post cessation date compared to the total cessation attempts, is 41.7% which is over the 40% target. However, there is considerable variation

across health boards in the proportion of treated smokers CO-validated as successfully stopping smoking. Cwm Taf Morgannwg UHB, Aneurin Bevan UHB and Hywel Dda UHB all have a similar success rate (between 37.5-43.5%), the lowest success rate is in Betsi Cadwaladr UHB (33.9%) compared to the highest rates in Cardiff and Vale UHB (just under 60%) and Swansea Bay UHB (52.6%).

Overall, the highest success rate in Wales is in the hospital services (47.8%), however, this service only makes up a small proportion of people treated for most health boards. Generally, the most widely used services in Wales are pharmacy level 3 services. The success rate for this service is fairly low in Hywel Dda UHB (41%) and in Aneurin Bevan UHB, Cwm Taf Morgannwg UHB and Betsi Cadwaladr UHB is less than the 40% target. In contrast to this, the success rate is far higher in Cardiff and Vale UHB and Swansea Bay UHB (84.1% and 61.4% respectively). Although the number of people using pharmacy services is low in Cardiff and Vale UHB the success rate of the service is very high. Similarly, Help Me Quit community services in Cardiff also have the highest success rate (50.4%).

The Help Me Quit cessation data presented in this section is important to highlight different levels of engagement and success rates of the various Help Me Quit services across health boards. Some health boards such as Cardiff and Vale UHB have a high success rate but low engagement whereas others such as Betsi Cadwaladr have a higher engagement level but low quit success rates. All health boards need to improve their engagement with these services to hit the 5% smoking population target. A collaborative response may be useful across health boards to share best practice of how to engage with a larger number of smokers and best practice within services to improve the quit success rate. Importantly the data presented here shows which services smokers are engaging with more in each health board therefore may help with focusing resources into those services or in health boards where the rate of CO-validation as successfully stopping smoking is low it may suggest that it could be beneficial to look at ways to increase engagement with other services. Across all health boards, consideration should be given to improve engagement with Help Me Quit for Baby services.

Unfortunately, currently, smoking cessation data is not broken down by local authority, sex, age, ethnicity, or deprivation quintile, all of which are essential to understanding the reach and limitations of the services. This information is important to understand whether cessation services are reaching the groups in most need of targeting for cessation support such as areas with higher smoking rates and higher levels of deprivation. It is therefore recommended that in future, smoking cessation data is broken down by local authority, age, sex, ethnicity and deprivation quintiles where possible to enable better assessment of the reach of current smoking cessation services and to identify areas where improvements need to be made to target the groups in greater need of cessation support to address smoking inequalities.

Barriers to smoking cessation

There are several groups that face greater barriers to smoking cessation and accessing the support needed. This includes people living in more deprived areas, within which smoking rates are considerably higher than the least deprived groups, the reasons for which were explored in sections 2 and 3. In this section the main focus is on barriers faced by people living in more deprived areas and how these barriers may be overcome. It is also important to consider that men and women may experience different barriers to smoking cessation

and here some of those differences will be highlighted as to why it is important to consider them when tailoring cessation support.

What barriers to smoking cessation are faced by more deprived smokers?

It has been shown that people living in more deprived areas make similar numbers of cessation attempts as people from less deprived backgrounds, but these attempts are less likely to be successful in smokers experiencing financial difficulties (79) and they are less likely to adhere to treatment (10). Since their introduction, smoking cessation services were supposed to target more economically deprived populations (80). Previous studies in England showed that although smokers from more deprived areas had a lower cessation success rate, the services reached a greater number of lower socioeconomic status individuals, resulting in positive discrimination which offset the effects of the lower success rate (80). However, it was suggested that the effect on improving inequalities was likely to be small (80). Therefore, to address inequalities the services need to reach a greater number of people living in more deprived areas and identify and address barriers to cessation to improve the cessation success rates.

ASH reported that smokers who are struggling due to unmet socioeconomic or psychosocial needs are unlikely to see smoking cessation as a priority (10). There are several barriers faced by smokers from more deprived areas. For example:

- Smokers from this group tend to have a higher nicotine dependency, particularly in older smokers who have been smoking for many years (10) (81) (82).
- Smokers living in more deprived circumstances tend to experience greater life stress due to socioeconomic factors, which are a reason for increased smoking rates within these groups and a greater dependency on smoking to help cope with these stressors acts as a barrier to cessation (10) (82).
- Smoking perceptions tend to be different within these groups with a belief that smoking is more normal compared to less deprived groups (83) (10).
- A lack of social support has also been proposed as an important barrier to smoking cessation (84) (10).
- Lower motivation to quit has also been cited as a barrier to smoking cessation within these groups, which has been linked to the level of self-efficacy, quit confidence and social support (85).
- It has been shown that people from low socioeconomic groups are also more likely to rationalise and justify smoking behaviour as a form of risk minimising beliefs (86) (85) which in turn can result in lower motivation to quit.

There may also be practical barriers such as access to services and the need for flexible tailored cessation services. It is also important to note that when looking at the WIMD access to services domain it only takes into account travel time to GP surgeries and pharmacies and does not take into account travel distance to hospitals or other health care providers.

How can these barriers to smoking cessation be overcome and engage more groups experiencing higher levels of deprivation?

In order to tackle smoking inequalities and the resultant health inequalities, smoking cessation services need to do more to overcome these barriers and drive down smoking rates particularly in the most socio-economically deprived groups. Firstly, more needs to be done to engage more people living in more deprived areas with smoking cessation services.

This could be achieved through increased targeted campaigns promoting smoking cessation services. Work by ASH has suggested that when promoting smoking cessation, messages need to be clear and simple and delivered by an appropriate person with former smokers and healthcare professionals both cited as good potential candidates (87). It is essential to consider people living in more deprived areas as the target audience for this (87). Any messages within these campaigns would need to be informative, attention grabbing and directly address the risk minimising beliefs prevalent among more deprived smokers (87).

It is important to consider the reach of campaigns to maximise engagement from more deprived smokers and consider how both men and women can be engaged. Potentially, campaigns need to look beyond traditional channels of engagement and take lessons from other lung cancer health campaigns such as the 'Do It For Yourself' campaign which was primarily aimed at men but was inclusive where possible (88). This campaign issued DIY messages to promote a positive call to action on possible lung cancer symptoms. What is interesting in this campaign was the use of alternative channels to reach the target audience. They used some traditional ways to communicate the message such as radio adverts, posters and bus-sides but they also incorporated alternative ways to communicate the message, such as pharmacy bags and pub drinks coasters (88). The report following the 'Do It For Yourself' lung cancer health campaign suggested it had good reach and that the campaign generated over 35 million opportunities for the campaign messages to be seen (88). Although, it was hard to measure the effects of the campaign in terms of increased help-seeking behaviour there was some evidence that it had a positive effect with slightly increased suspected lung cancer referrals in 6 out of 8 cancer alliances (88). However, this data needs to be treated with caution as there are other factors which may affect this, and increases were also seen in the control group and there was variability across areas (88).

Traditionally people from more deprived backgrounds have been termed 'hard to reach' due to their lower engagement with health campaigns (89). However, it must be considered that traditional health campaigns were not fit for purpose to engage this group, therefore novel approaches need to be explored. A similar idea of pub drinks coasters could be explored with smoking cessation, particularly as there are links between tobacco and alcohol use (90). Additionally, it may be beneficial to introduce the ideas of smoking cessation in more relaxed settings rather than primarily a medical context for example, where smokers may feel that they are being lectured or add to the perceived blame and stigma for their smoking behaviour. Other potential alternative places of engagement for people living in more deprived areas may be settings such as food banks (87), financial charities, job centres and housing services and it may be beneficial to include the potential motivating financial factor in messaging.

In addition to improving the reach of the smoking cessation services, the services themselves also need to be optimised to improve the rates of smoking cessation among those living in more deprived areas. It is already known that smoking cessation services offer the best chances of successful cessation compared to other options such as going it alone (35), but these services can be optimised to tackle smoking inequalities linked to deprivation. For example, in older deprived smokers behavioural support along with pharmacotherapy has shown promise (82). Evidence has shown that smokers that receive behavioural support are more likely to succeed than those that did not (91) (82). This may be particularly important in those living in more deprived areas where increased stress can be a motivating factor for continued smoking and support addressing those links and exploring other ways to cope may be important.

There are other factors to consider such as the setting for smoking cessation services. Community settings can be good places for cessation services (82), and it is important that the services are both accessible and flexible (92) (82). The provider of services may also be important to consider such as whether it will be provided by GPs, nurses or peer facilitators, with some evidence for the benefits of the latter with people feeling able to share experiences and advice/tips in group settings (93) (82). Other aspects are also likely to be valuable in cessation services such as ensuring there is a lack of judgement (94) and following up with people after an unsuccessful attempt to re-engage them with smoking cessation services (95). There is also a need to tailor cessation services and nicotine replacement therapy to individuals to enable things such as comorbidities to be considered (96) (85). Unfortunately, smoking cessation may not be a priority until other socio-economic needs have been met, so there may be value in the linking of cessation activities to other social benefits provision services.

Whilst men and women on average make equal cessation attempts, evidence suggest that women seem to be 31% less successful (97). This difference was explored in a small qualitative study (94). Although barriers relating to stress, mood and social aspects were reported by both sexes, it was shown that women were more likely to smoke out of habit or to regulate mood and report internal barriers to cessation such as stress and craving, and concerns relating to weight gain (94)(98). Whereas men on average were more likely to smoke due to the stimulating effects of nicotine but were more likely to report external barriers to cessation such as availability of cigarettes and the social aspects of smoking (94)(98). Both males and females felt it was important to talk about smoking without pressure or judgement and that there is a need for more recognition of smoking as an addiction rather than simply a lifestyle choice (94). Although more work is needed to understand differences in barriers to smoking cessation between males and females it is important that this is considered by smoking cessation services as they may need to be tailored according to sex.

This section has highlighted that there are differences in the level of engagement with NHS smoking cessation services across health boards in Wales. There are also differences in terms of which NHS Help Me Quit services are utilised across different health boards accompanied by varying quit success rates. A more collaborative approach may help all health boards improve these services.

Recommendations

- A more collaborative approach should be taken between Help Me Quit services across health boards to share best practices in terms of engagement and success rates.
- Smoking cessation campaigns should be tailored to engage more people living in more deprived areas and explore alternative communication channels, taking lessons from campaigns such as 'Do It For Yourself' such as health related drinks mats.
- Cessation services need to be tailored to increase the suitability of services to more deprived groups and take into consideration the barriers faced by these groups.
- Differences in barriers to smoking cessation between men and women should be considered and if necessary separate campaigns targeting men and women should be considered.

7. Lung health checks and screening

Earlier diagnosis of lung cancer at a more treatable stage would significantly improve lung cancer outcomes in Wales. Evidence from lung cancer screening trials using low-dose computed tomography (LDCT) scans both in England and other countries has shown that lung screening drastically increases the proportion of tumours diagnosed at an early stage (99), (100) (101). For example, the UK Lung Cancer Screening (UKLS) trial had a 1.7% lung cancer prevalence and around 85% of tumours were diagnosed at an early stage (99). Additionally, the National Lung Cancer Screening Trial (NLST) in America showed that LDCT screening resulted in a 20% lower lung cancer mortality rate compared to chest radiography (100). Therefore, it is recommended that pilot lung health checks which include LDCT in high-risk individuals is introduced in Wales and this is something which Tenovus Cancer Care is already strongly endorsing and actively working to get these pilot schemes introduced.

However, it is important that the introduction of lung health checks and screening work to reduce the lung cancer inequalities which exist in Wales rather than exacerbate the issue. It is already known that in other screening programmes such as bowel cancer screening a gradient of uptake exists across socioeconomic groups with people living in more deprived areas less likely to complete the screening (102). Additionally, differences in bowel cancer screening uptake between sexes has also been reported, with generally women more likely to engage with the initial non-invasive screening tests, however, the inverse pattern has been reported for follow-up more invasive tests with men more likely to engage (103). Differences in uptake according to socio-economic status have also been reported for breast and cervical cancer screening (104). These screening procedures require a clinical appointment therefore some potential barriers to participation in more deprived groups have been suggested to be time, transport and discomfort interacting with medical professionals/environments (104). As lung cancer screening would also require a clinical appointment it is possible that some of the same barriers may be experienced.

Therefore, to prevent similar patterns of inequalities in uptake of lung cancer screening according to socioeconomic group it is important to understand the attitudes towards screening and the barriers to participation experienced among more deprived groups. Indeed, there is some evidence from UK trials for a low response rate from target groups. A study which looked at the response rate to the initial questionnaire sent out to determine lung cancer risk in the UKLS trial found that an increased response rate was associated with higher socio-economic groups which also inversely correlated with risk (105). They also reported that following an invite, clinical attendance was higher in higher socioeconomic status groups (105). It was reported that the group least likely to respond was never smokers within the most deprived quintiles but worryingly the next least likely to respond were current smokers in the most deprived quintiles (105) who are a target population for lung cancer screening to address lung cancer inequalities. This study also importantly highlighted that former smokers are more likely to engage with the lung health programme than current smokers (105). The study did show that although there was a lower response rate to the initial questionnaire from more deprived groups, a proportionate number of individuals from these groups were invited for the lung screening process due to high lung cancer risk within these groups (105). The results from this study are important because they show that the target groups for lung cancer screening are less likely to engage with it.

In contrast, multiple subsequent lung health screening trials in England have reported much higher recruitment from more people living in more deprived areas. For example, one pilot

consisted of lung health checks in deprived areas of Manchester whereby individuals registered at participating GP practices were recruited by invitation to community-based lung health checks (106). It was reported that demand for these lung health checks was high with appointments filling fast, of which 52% of individuals qualified for LDCT screening and importantly it was reported that the median deprivation rank for participants was within the lowest decile in England suggesting this approach worked well to engage more people living in more deprived areas (106). It is also important to note the positive results from the trial with a lung cancer prevalence of 3% and 80.4% of cancers diagnosed at an early stage (106). Additionally, a pilot in South Tyneside and Sunderland reported that 79.3% of individuals screened were within the most deprived quintiles, in this trial individuals were identified for screening at their annual COPD review suggesting this may also be a feasible way to engage more individuals from more deprived groups (107).

To improve engagement with lung cancer screening programmes from more deprived groups who have typically been failed to engage in other cancer screening programmes it is important to understand the barriers to participation. A study by Ali et al 2015 found that factors associated with non-participation in the UKLS trial were female gender, older age, current smoking, lower socioeconomic status group and higher affective risk perception (108). The study also showed that the most commonly cited barriers to participation were practical barriers such as travel and comorbidities along with factors such as carer responsibilities (108). However, they also showed that emotional barriers such as avoidance of lung cancer information and fear were factors in non-participation and were more common in current smokers (108).

Other studies have also shown emotional barriers to be important in low socioeconomic status groups, a small qualitative study on patients declining participation in a screening trial (Lung SEARCH) identified four attitudes related to reluctance in participation including worry, fear, fatalism and believing themselves to be too old to benefit (109). Indeed a study by Quaife et al 2017 also showed that a higher proportion of current smokers within more economically deprived groups perceived their risk of lung cancer as high compared to former smokers (110). However, this group were also more likely than former smokers to agree with statements such as “smoked too long to benefit” and were more likely to hold fatalistic beliefs about lung cancer with just under half agreeing lung cancer is “a death sentence” (110). This study also found that lots of smokers and former smokers from more deprived groups were superficially supportive of lung cancer screening but when probing deeper people also held contradictory beliefs about treatment and survival, especially older smokers (110). It was also found that stigma and perceived blame of lung cancer as a self-inflicted smokers’ disease also had a role in acting as a social deterrent of screening participation (110).

Finally, it is worth noting the key findings from a recent CRUK report (111), Lung Cancer Screening Project, 2022. The project surveyed 4,158 people, including current smokers (n=572), former smokers (n=1287), and never smokers (n=2299). The research found that, whilst smokers recognised that they have a higher risk of cancer (p.6), this group was more likely to refuse lung cancer screening than former or never smokers. Understanding of the importance of early diagnosis is also lowest in current smokers, compared to former smokers and those who have never smoked: 12% of current smokers agreed with the statement ‘it’s okay to wait before seeking help for symptoms that could be cancer because it doesn’t matter how early it is diagnosed’. Importantly, they are more likely to think this than former (5%) or non-smokers (7%) (p.7). The majority of current smokers worry at least

occasionally about getting lung cancer and are more than three times as likely to worry constantly/frequently than former smokers. (p12).

On the whole, the research found that most people were positive about the introduction of lung cancer screening, and 89% surveyed thought that lung cancer screening could help detect cancer sooner (p22). There were, however, some concerning findings amongst those who would not accept lung cancer:

- Those who worry more frequently about getting cancer are less likely to agree to lung cancer screening (p12)
- Those who would not accept the offer of a lung cancer screening are less likely to agree that currently smoking, air pollution, and family history are risk factors of lung cancer. (p15)
- Only one-tenth would not attend a lung cancer assessment if invited. However, current smokers are less likely to report they would say yes. Former smokers are most likely to report they would say yes (p20)
- Less than one-tenth would decline to attend a lung cancer screening after being deemed higher risk. Again, however, current smokers are less likely than non smokers or former smokers to report they would take up the offer a lung cancer screening (p21)
- Former smokers are most likely to recognise the potential benefits of LCSs, but current smokers are least likely to (p.23).
- 44% of those who would **not** take up an offer of LCS said they'd be too scared about having lung cancer to participate (p.25)

This section highlights the need for addressing these complex barriers to participation when introducing lung health checks and cancer screening. There is a need for targeted screening for more deprived groups/areas to tackle lung cancer inequalities. Some trials have shown potentially effective ways to engage with those living in more deprived areas through community lung health checks and recruiting participants via annual COPD reviews. However, it is important to consider that current smokers within the most deprived groups are the second least likely to respond to invitations for lung health checks and there are a multitude of practical and emotional barriers to participation. To overcome some of the practical barriers it is likely that lung health checks within community settings or using mobile scanners is likely to increase engagement with target groups, but appointments will also need to be flexible to address time barriers. It is important that consideration is given to complex emotional barriers to participation and communication needs to address fears and fatalistic beliefs and normalise invitation to reduce the panic that may be experienced from receiving an invite (110). Communication must avoid language that may invoke feelings of judgement which adds to perceived stigma and should focus on the benefits of screening and how it improves early detection which has better outcomes.

Recommendations

- Lung cancer health checks and screening trails should be introduced in Wales and a focus should be placed on targeting people in deprived areas, with initial trails based in the most deprived areas where smoking rates are highest and lung cancer outcomes poorest such as Merthyr Tydfil/Rhondda Cynon Taf.

- Lung cancer screening needs to be accessible and flexible to engage more deprived groups; community/mobile screening units are recommended.
- Communication around/Invitations to lung health checks need to carefully consider emotional barriers to participation and actively address fear and beliefs of having smoked too long to benefit, with a focus on promoting the benefits of participating in screening.

8. Conclusions and recommendations

Lung cancer inequalities exist in Wales according to financial deprivation, geography and sex. The most financially deprived groups face a greater lung cancer burden in terms of incidence and also unequal outcomes with lower survival and higher mortality rates. It is clear that geographical lung cancer inequalities also exist, with some areas experiencing higher lung cancer rates. These geographical lung cancer inequalities likely relate to measures of deprivation. To fully understand these geographical inequalities, it is important to look within health boards; looking at a local authority level or even LSOA enables a more detailed interrogation of the inequalities faced. The lung cancer inequalities that exist in Wales are largely driven by smoking which is linked to levels of deprivation. When investigating the links between deprivation, smoking and lung cancer it is important that we look beyond solely income deprivation. Multiple measures of deprivation link with increased smoking rates which in turn drive lung cancer inequalities. Lung cancer inequalities based on sex are also experienced in Wales with men having higher incidence and worse outcomes. Traditionally, differences in lung cancer have been put down to smoking and help seeking behaviour. However, it is becoming clear that the differences between men and women may be more complex and this is an area that requires more consideration and further investigation.

Throughout this report it has been recommended that to tackle these inequalities, greater focus needs to be placed on improving smoking cessation services and the introduction of lung cancer screening in Wales. However, further compounding the lung cancer inequalities that exist, people living in more deprived areas face greater barriers to engagement with smoking cessation and cancer screening programmes. This report has highlighted the plethora of barriers faced by target groups, and to ensure smoking cessation services and lung cancer screening tackle inequalities consideration needs to be given to these barriers. Finally, it has been highlighted that there may be differences in the barriers to engagement for men and women and any smoking cessation services which wish to target specific groups of people must take these differences into consideration.

1. **Look beyond income deprivation for links between deprivation, smoking and lung cancer.** There are links between multiple WIMD deprivation domains and smoking and more consideration should be given to domains other than income when exploring the links between deprivation, smoking and lung cancer. Particularly, more focus should be given to the health and education domains.
2. **Improve smoking cessation services and introduce lung cancer screening in Wales.** To tackle lung cancer inequalities in Wales a focus should be put on prevention and early detection. In order to achieve this, cessation services and lung cancer screening programmes need to be targeted at more deprived groups. A range of barriers to engagement with these services has been identified in more deprived groups. Therefore, these services need to be tailored to consider these barriers and overcome them to increase engagement. Such as facilities within community settings to improve access to these services and carefully considered language in communications to address emotional barriers.
3. **More data must be gathered at a local authority level.** In order to better understand geographical inequalities in lung cancer that exist in Wales and their relation to smoking and deprivation, more data should be published at a local

authority level e.g. smoking cessation data. Publishing data at this lower geographical level would allow better exploration of inequalities that exist and allow policies and recommendations tailored to address these inequalities.

4. **Lung cancer and smoking inequalities by sex should be given more consideration.** There are potential differences in lung cancer risk, help seeking behaviour and barriers to smoking cessation between sexes. Further investigation is required to better understand these differences. More consideration should be given to these differences, and as evidence emerges smoking cessation and screening programmes may need to be tailored to engage men and women differently.

Importantly, there is also a need to understand how inequalities in treatment arise and how to address these. It may be important to investigate if there are geographical inequalities in treatment in Wales. If there are geographical inequalities, then health boards could adopt a more collaborative approach to ensure people across Wales and particularly from deprived areas get the same access to treatments. Additionally, it may be useful to research rates of declining lung cancer treatments and whether they are higher in more deprived groups, as these groups tend to have lower health education and hold more fatalistic beliefs. If there are differences in refusal of treatment health boards need to evaluate their communications with patients to ensure that all patients understand their treatment options fully to make informed decisions.

References

1. Welsh Government. 2021. *Relative income poverty: April 2019 to March 2020*. [online] Available at: <<https://gov.wales/relative-income-poverty-april-2019-march-2020-html#:~:text=Between%202017%2D18%20and%202019,Wales%20for%20over%2015%20years.>> [Accessed 5 April 2022].
2. Davies, R., et al. 2011. An anatomy of economic inequality in Wales. *Wales Institute of Social and Economic Research, Data and Methods (WISERD)*.
3. Welsh Government. 2019. *Welsh Index of Multiple Deprivation (WIMD) 2019 Technical report*. [online] Available at: <<https://gov.wales/sites/default/files/statistics-and-research/2020-02/welsh-index-multiple-deprivation-2019-technical-report.pdf>> [Accessed 6 April 2022].
4. Welsh Government. 2019. *Welsh Index of Multiple Deprivation: index guidance*. [online] Available at: <<https://gov.wales/welsh-index-multiple-deprivation-index-guidance>> [Accessed 6 April 2022].
5. UK Government. 2018. *Health profile for England: 2018 Chapter 5: inequalities in health*. [online] Available at: <<https://www.gov.uk/government/publications/health-profile-for-england-2018/chapter-5-inequalities-in-health>> [Accessed 6 April 2022].
6. Department of Health and Social Security. 1980. *Inequalities in health: Report of a research working group*. London: Department of Health and Social Security.
7. Marmot, M., Allen, J., Goldblatt, P., et al. 2010. *Fair Society, Healthy Lives – The Marmot Review: Strategic review of health inequalities in England post-2010*. UK: The Marmot Review.
8. Marmot, M., 2020. Health equity in England: the Marmot review 10 years on. *BMJ*, 368, m693.
9. Public Health Wales Observatory. 2016. *Measuring inequalities 2016 - Trends in mortality and life expectancy in Wales*. [online] Available at: <<https://phw.nhs.wales/services-and-teams/observatory/data-and-analysis/measuring-inequalities-2016/>> [Accessed 6 April 2022].
10. Action on Smoking and Health. 2019. *Health Inequalities and Smoking*. [online] Available at: <https://ash.org.uk/wp-content/uploads/2019/09/ASH-Briefing_Health-Inequalities.pdf> [Accessed 6 April 2022].
11. StatsWales Welsh Government. 2020. *Adult lifestyles by WIMD deprivation quintile, 2016-17 to 2019-20*. [online] Available at: <<https://statswales.gov.wales/Catalogue/National-Survey-for-Wales/Population-Health/Adult-Lifestyles/adultlifestyles-by-wimddeprivation>> [Accessed 6 April 2022].
12. NHS. 2019. *Lung cancer - Causes*. [online] Available at: <<https://www.nhs.uk/conditions/lung-cancer/causes/>> [Accessed 7 April 2022].
13. Welsh Cancer Intelligence and Surveillance Unit - Public Health Wales. 2021. *Cancer Incidence in Wales, 2002-2018*. [online] Available at: <<https://phw.nhs.wales/services-and-teams/welsh-cancer-intelligence-and-surveillance-unit-wcisu/cancer-incidence-in-wales-2002-2018/>> [Accessed 6 April 2022].
14. Public Health Wales - WHO Collaborating Centre on Investment for Health and Well-being. 2022. *International Horizon Scanning and Learning to Inform Wales' COVID-19 Public Health Response and Recovery - Summary Report On the impact of COVID-19 on increasing the Health Gap and Vulnerability*. [online] Available at: <<https://phwwhocc.co.uk/wp-content/uploads/2022/02/Horizon-Scanning-Report-English-Inequalities-final.pdf>> [Accessed 6 April 2022].
15. Public Health Wales - WHO Collaborating Centre on Investment for Health and Well-being. 2021. *Placing health equity at the heart of the COVID-19 sustainable response and recovery: Building prosperous lives for all in Wales*. [online] Available at: <<https://phw.nhs.wales/news/placing-health-equity-at-the-heart-of-coronavirus-recovery-for-building-a-sustainable-future-for-wales/placing-health-equity-at-the-heart-of-the-covid-19-sustainable-response-and-recovery-building-prosperous-lives-for-all-in-wales/>> [Accessed 6 April 2022].

16. Quinn-Scoggins, H., Cannings-John, R., Moriarty, Y., *et al.* 2021. Cancer symptom experience and help-seeking behaviour during the COVID-19 pandemic in the UK: a cross-sectional population survey. *BMJ Open*, 11(9), p.e053095.
17. Macmillan cancer support. 2020. *The Forgotten 'C'? The impact of Covid-19 on cancer care.* [online] Available at: <<https://www.macmillan.org.uk/assets/forgotten-c-impact-of-covid-19-on-cancer-care.pdf>> [Accessed 6 April 2022].
18. Cross Party Group on Cancer. 2020. *The single cancer pathway: next steps to achieve earlier diagnosis in Wales Inquiry into Cancer Waiting Times.* [online] Available at: <https://www.sor.org/getmedia/118d2102-7f81-4f2c-bf7b-b86cb7336e31/cpgc_-_the_single_cancer_pathway_november_2020_full_report.pdf> [Accessed 6 April 2022].
19. All Party Parliamentary Group for Respiratory Health. 2021. *APPG Report Lung Cancer Recovery After COVID.* [online] Available at: <https://www.appg-respiratory.co.uk/sites/appg/files/2021-11/Lung%20Cancer%20Report%2011-21_0.pdf> [Accessed 6 April 2022].
20. StatsWales Welsh Government. n.d. *Cancer waiting times.* [online] Available at: <<https://statswales.gov.wales/Catalogue/Health-and-Social-Care/NHS-Hospital-Waiting-Times/Cancer-Waiting-Times>> [Accessed 6 April 2022].
21. Office for National Statistics. 2018. *Likelihood of smoking four times higher in England's most deprived areas than least deprived - Office for National Statistics.* [online] Available at: <<https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/drugusealcoholandsmoking/articles/likelihoodofsmokingfourtimeshigherinenglandsmostdeprivedareasthanleastdeprived/2018-03-14>> [Accessed 1 April 2022].
22. Action on Smoking and Health Wales. 2016. *ASH briefing: health inequalities and smoking.* [online] Available at: <<https://ash.org.uk/information-and-resources/briefings/ash-briefing-health-inequalities-and-smoking/>> [Accessed 1 April 2022].
23. Action on Smoking and Health. n.d. *Smoking and inequalities.* [online] Available at: <<https://ash.wales/campaign/smoking-and-inequalities/#1525163183221-02c83f27-efea>> [Accessed 1 April 2022].
24. Benzeval, M., Bond, L., Campbell, M., Egan, M., Lorenc, T., Petticrew, M. and Popham, F., 2014. How does money influence health?. *Joseph Rowntree Foundation*, [online] Available at: <<https://www.jrf.org.uk/report/how-does-money-influence-health#:~:text=The%20more%20money%20families%20have,body%2C%20eventually%20causing%20ill%20health.>> [Accessed 1 April 2022].
25. Action on Smoking and Health Scotland. 2018. *The role of stopping smoking in money advice – putting health and economic benefits together: NHS Greater Glasgow and Clyde Smokefree Services and ASH Scotland.* [online] Available at: <https://www.ashscotland.org.uk/media/7226/Money_Advice_Report_Full_Final.pdf> [Accessed 1 April 2022].
26. Office for National Statistics. 2020. *Adult smoking habits in the UK: 2019.* [online] Available at: <<https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandlifeexpectancies/bulletins/adultsmokinghabitsingreatbritain/2019#:~:text=In%20the%20UK%2C%20in%202019,2018%20to%2014.1%25%20in%202019.>> [Accessed 1 April 2022].
27. De Vogli, R. and Santinello, M., 2005. Unemployment and smoking: does psychosocial stress matter?. *Tobacco Control*, 14(6), pp.389-395.
28. Action on Smoking and Health. 2020. *Smoking, employability, and earnings.* [online] Available at: <<https://ash.org.uk/wp-content/uploads/2020/09/SmokingEmployability.pdf>> [Accessed 1 April 2022].
29. Emerson, E., 2018. Smoking among adults with and without disabilities in the UK. *Journal of Public Health*, 40(4), pp.e502-e509.
30. Tobacco Free Life. 2016. *Smoking Among Adults with Disabilities: Why It's a Big Problem.* [online] Available at: <<https://tobaccofreelife.org/resources/smoking-adults-disabilities/>> [Accessed 6 April 2022].
31. Salt, V. and Osborne, C., 2020. Mental health, smoking and poverty: benefits of supporting smokers to quit. *BJPsych Bulletin*, 44(5), pp.213-218.

32. Cavelaars, A., Kunst, A., Geurts, J., *et al.* 2000. Educational differences in smoking: international comparison. *BMJ*, 320, pp. 1102.
33. Huisman, M., Kunst, A. and Mackenbach, J., 2005. Inequalities in the prevalence of smoking in the European Union: comparing education and income. *Preventive Medicine*, 40(6), pp.756-764.
34. Shohaimi, S., Luben, R., Wareham, N., Day, N., Bingham, S., Welch, A., Oakes, S. and Khaw, K., 2003. Residential area deprivation predicts smoking habit independently of individual educational level and occupational social class. A cross sectional study in the Norfolk cohort of the European Investigation into Cancer (EPIC-Norfolk). *Journal of Epidemiology & Community Health*, 57(4), pp.270-276.
35. Help Me Quit. 2022. *What Choices Do I Have To Stop Smoking? | Help Me Quit*. [online] Available at: <<https://www.helpmequit.wales/what-choices-are-there-for-me/>> [Accessed 5 April 2022].
36. Shortt, N., Tisch, C., Pearce, J., Mitchell, R., Richardson, E., Hill, S. and Collin, J., 2015. A cross-sectional analysis of the relationship between tobacco and alcohol outlet density and neighbourhood deprivation. *BMC Public Health*, 15(1), p.1014.
37. British Medical Association. 2017. *Health at a price - Reducing the impact of poverty*. [online] Available at: <<https://www.bma.org.uk/media/2084/health-at-a-price-2017.pdf>> [Accessed 5 April 2022].
38. Cancer Research UK. 2021. *How can air pollution cause cancer?*. [online] Available at: <<https://www.cancerresearchuk.org/about-cancer/causes-of-cancer/air-pollution-radon-gas-and-cancer/how-can-air-pollution-cause-cancer>> [Accessed 6 April 2022].
39. Gadd, L. and Davis, L., 2022. *Healthy Planet, Healthy People - Philanthropy briefing on the intersection of the environment and human health*. [online] NPC. Available at: <<https://www.thinknpc.org/wp-content/uploads/2022/01/NPC-EFN-healthy-planet-healthy-people-briefing.pdf>> [Accessed 6 April 2022].
40. Brown, K., Runggay, H., Dunlop, C., *et al.* 2018. The fraction of cancer attributable to modifiable risk factors in England, Wales, Scotland, Northern Ireland, and the United Kingdom in 2015. *British Journal of Cancer*, 118(8), pp.1130-1141.
41. Cancer Research UK. 2022. *Cancer in the UK 2020: Socio-economic deprivation*. [online] Available at: <https://www.cancerresearchuk.org/sites/default/files/cancer_inequalities_in_the_uk.pdf> [Accessed 6 April 2022].
42. Macmillan cancer support. 2017. *Deprivation and Survival from Lung Cancer in Scotland*. [online] Available at: <https://www.macmillan.org.uk/_images/Lung-Cancer-Survival-and-Deprivation-Brief_tcm9-308842.pdf> [Accessed 6 April 2022].
43. British Lung Foundation. n.d. *Lung cancer statistics*. [online] Available at: <<https://statistics.blf.org.uk/lung-cancer>> [Accessed 6 April 2022].
44. Riaz, S., Horton, M., Kang, J., Mak, V., Lüchtenborg, M. and Møller, H., 2011. Lung Cancer Incidence and Survival in England: An Analysis by Socioeconomic Deprivation and Urbanization. *Journal of Thoracic Oncology*, 6(12), pp.2005-2010.
45. Niksic, M., Ratchet, B., Warburton, F., Wardle, J., Ramirez, A. and Forbes, L., 2015. Cancer symptom awareness and barriers to symptomatic presentation in England—are we clear on cancer?. *British Journal of Cancer*, 113(3), pp.533-542.
46. Abel, G., Shelton, J., Johnson, S., Elliss-Brookes, L. and Lyratzopoulos, G., 2015. Cancer-specific variation in emergency presentation by sex, age and deprivation across 27 common and rarer cancers. *British Journal of Cancer*, 112, pp.S129-S136.
47. Senedd Research Welsh Parliament. 2021. *A smoke-free Wales*. [online] Available at: <<https://research.senedd.wales/research-articles/a-smoke-free-wales/>> [Accessed 6 April 2022].
48. Welsh Government. 2019. *Statistical Bulletin - National Survey for Wales 2018-19: Adult smoking and e-cigarette use*. [online] Available at: <<https://gov.wales/sites/default/files/statistics-and-research/2019-11/adult-smoking-and-e-cigarette-use-national-survey-wales-april-2018-march-2019-437.pdf>> [Accessed 6 April 2022].

49. Action on Smoking and Health. n.d. *Illegal tobacco*. [online] Available at: <<https://ash.wales/campaign/illegal-tobacco/>> [Accessed 6 April 2022].
50. Welsh Cancer Intelligence and Surveillance Unit - Public Health Wales. 2022. *Cancer mortality in Wales, 2002 - 2021*. [online] Available at: <<https://phw.nhs.wales/services-and-teams/welsh-cancer-intelligence-and-surveillance-unit-wcisu/cancer-mortality-in-wales-2002-2021/>> [Accessed 6 April 2022].
51. Welsh Cancer Intelligence and Surveillance Unit - Public Health Wales. 2021. *Cancer Survival in Wales, 2002-2018*. [online] Available at: <<https://phw.nhs.wales/services-and-teams/welsh-cancer-intelligence-and-surveillance-unit-wcisu/cancer-survival-in-wales-2002-2018/>> [Accessed 6 April 2022].
52. Nur, U., Quaresma, M., De Stavola, B., Peake, M. and Rachet, B., 2015. Inequalities in non-small cell lung cancer treatment and mortality. *J Epidemiol Community Health*, 69, pp.985-992.
53. Peake, M., 2014. Deprivation, distance and death in lung cancer. *Thorax*, 70(2), pp.108-109.
54. Forrest, L., Adams, J., Wareham, H., Rubin, G. and White, M., 2013. Socioeconomic Inequalities in Lung Cancer Treatment: Systematic Review and Meta-Analysis. *PLoS Medicine*, 10(2), p.e1001376.
55. Powell, H., 2019. Socioeconomic deprivation and inequalities in lung cancer: time to delve deeper?. *Thorax*, 74, pp.11-12.
56. Welsh Government. 2019. *Welsh Index of Multiple Deprivation (WIMD) 2019 Results report*. [online] Available at: <<https://gov.wales/sites/default/files/statistics-and-research/2020-06/welsh-index-multiple-deprivation-2019-results-report.pdf>> [Accessed 6 April 2022].
57. StatsWales Welsh Government. 2020. *Adult lifestyles by local authority and health board, 2016-17 to 2019-20*. [online] Available at: <<https://statswales.gov.wales/Catalogue/National-Survey-for-Wales/Population-Health/Adult-Lifestyles/adultlifestyles-by-localauthority-healthboard>> [Accessed 6 April 2022].
58. Lawrenson, R., Lao, C., Brown, L., *et al.* 2020. Management of patients with early stage lung cancer – why do some patients not receive treatment with curative intent?. *BMC Cancer*, 20, 109.
59. Sagerup, C., Smastuen, M., Johannesen, T., Helland, A. and Brustugun, O., 2011. Sex-specific trends in lung cancer incidence and survival: a population study of 40 118 cases. *Thorax*, 66, pp.301-307.
60. Jemal, A., Travis, W., Tarone, R., Travis, L. and Devesa, S., 2003. Lung cancer rates convergence in young men and women in the United States: Analysis by birth cohort and histologic type. *International Journal of Cancer*, 105(1), pp.101-107.
61. MacLean, A., Hunt, K., Smith, S. and Wyke, S., 2017. Does gender matter? An analysis of men's and women's accounts of responding to symptoms of lung cancer. *Social Science & Medicine*, 191, pp.134-142.
62. StatsWales Welsh Government. 2020. *Adult lifestyles by age and gender, 2016-17 to 2019-20*. [online] Available at: <<https://statswales.gov.wales/Catalogue/National-Survey-for-Wales/Population-Health/Adult-Lifestyles/adultlifestyles-by-age-gender>> [Accessed 6 April 2022].
63. Tindle, H., Stevenson Duncan, M., Greevy, R., Vasan, R., Kundu, S., Massion, P. and Freiberg, M., 2018. Lifetime Smoking History and Risk of Lung Cancer: Results From the Framingham Heart Study. *JNCI: Journal of the National Cancer Institute*, 110(11), pp.1201–1207.
64. Peters, S., Huxley, R. and Woodward, M., 2014. Do smoking habits differ between women and men in contemporary Western populations? Evidence from half a million people in the UK Biobank study. *BMJ Open*, 4(12), p.e005663.
65. National Cancer Institute. n.d. *NCI Dictionary of Cancer Terms*. [online] Available at: <<https://www.cancer.gov/publications/dictionaries/cancer-terms/def/pack-year>> [Accessed 5 April 2022].

66. Olak, J. and Colson, Y., 2004. Gender differences in lung cancer: Have we really come a long way, baby?. *The Journal of Thoracic and Cardiovascular Surgery*, 128(3), pp.346-351.
67. Baiu, I., Titan, A., Martin, L., Wolf, A. and Backhus, L., 2021. The role of gender in non-small cell lung cancer: a narrative review. *Journal of Thoracic Disease*, 13(6), pp.3816-3826.
68. Ragavan, M. and Patel, M., 2022. The evolving landscape of sex-based differences in lung cancer: a distinct disease in women. *European Respiratory Review*, 31(163), 210100.
69. Colson, Y., Shepard, J. and Lennes, I., 2021. New USPSTF Guidelines for Lung Cancer Screening. *JAMA Surgery*, 156(6), pp.513–514.
70. Braybrook, D., Witty, K. and Robertson, S., 2011. Men and lung cancer: a review of the barriers and facilitators to male engagement in symptom reporting and screening. *Journal of Men's Health*, 8(2), pp.93-99.
71. Song, F., Elwell-Sutton, T. and Naughton, F., 2020. Impact of the NHS stop smoking services on smoking prevalence in England: a simulation modelling evaluation. *Tobacco Control*, 29, pp.200-206.
72. Action on Smoking and Heath Wales. 2019. *Smoking and Inequalities Briefing Paper*. [online] Available at: <<https://ash.wales/wp-content/uploads/2019/03/inequalities-briefing-paper-.pdf>> [Accessed 9 April 2022].
73. GOV.WALES. 2021. *NHS smoking cessation services: quality report | GOV.WALES*. [online] Available at: <<https://gov.wales/nhs-smoking-cessation-services-quality-report-html>> [Accessed 3 April 2022].
74. NHS Wales. n.d. *Health in Wales - Smoking*. [online] Available at: <<http://www.wales.nhs.uk/healthtopics/lifestyles/smoking>> [Accessed 6 April 2022].
75. Dewis Cymru. 2022. *Quit smoking with free NHS support - Help Me Quit - Community Health*. [online] Available at: <<https://www.dewis.wales/ResourceDirectory/ViewResource.aspx?id=7119>> [Accessed 6 April 2022].
76. StatsWales Welsh Government. 2020. *Smoking cessation services*. [online] Available at: <<https://statswales.gov.wales/Catalogue/Health-and-Social-Care/NHS-Performance/smoking-cessation-services>> [Accessed 6 April 2022].
77. Welsh Government. 2019. *Maternity and Birth Statistics, Wales 2018*. [online] Available at: <<https://gov.wales/sites/default/files/statistics-and-research/2019-10/maternity-and-birth-statistics-2018-239.pdf>> [Accessed 3 April 2022].
78. NHS. 2019. *Stop smoking in pregnancy*. [online] Available at: <<https://www.nhs.uk/pregnancy/keeping-well/stop-smoking/#:~:text=Every%20cigarette%20you%20smoke%20contains,harder%20every%20ime%20you%20smoke.>>> [Accessed 4 April 2022].
79. Caleyachetty, A., Lewis, S., McNeill, A. and Leonardi-Bee, J., 2012. Struggling to make ends meet: exploring pathways to understand why smokers in financial difficulties are less likely to quit successfully. *The European Journal of Public Health*, 22(suppl 1), pp.41-48.
80. Bauld, L., Judge, K. and Platt, S., 2007. Assessing the impact of smoking cessation services on reducing health inequalities in England: observational study. *Tobacco Control*, 16(6), pp.400-404.
81. Siahpush, M., McNeill, A., Borland, R. and Fong, G., 2006. Socioeconomic variations in nicotine dependence, self-efficacy, and intention to quit across four countries: findings from the International Tobacco Control (ITC) Four Country Survey. *Tobacco Control*, 15(suppl_3), pp.iii71-iii75.
82. Smith, P., Poole, R., Mann, M., Nelson, A., Moore, G. and Brain, K., 2019. Systematic review of behavioural smoking cessation interventions for older smokers from deprived backgrounds. *BMJ Open*, 9(11), p.e032727.
83. Hiscock, R., Bauld, L., Amos, A., Fidler, J. and Munafò, M., 2011. Socioeconomic status and smoking: a review. *Annals of the New York Academy of Sciences*, 1248(1), pp.107-123.

84. Hiscock, R., Judge, K. and Bauld, L., 2010. Social inequalities in quitting smoking: what factors mediate the relationship between socioeconomic position and smoking cessation?. *Journal of Public Health*, 33(1), pp.39-47.
85. Smith, P., Daniel, R., Murray, R., Moore, G., Nelson, A. and Brain, K., 2021. Psychosocial determinants of quit motivation in older smokers from deprived backgrounds: a cross-sectional survey. *BMJ Open*, 11(5), p.e044815.
86. Guillaumier, A., Bonevski, B., Paul, C., D'Este, C., Twyman, L., Palazzi, K. and Oldmeadow, C., 2016. Self-Exempting Beliefs and Intention to Quit Smoking within a Socially Disadvantaged Australian Sample of Smokers. *International Journal of Environmental Research and Public Health*, 13(1), p.118.
87. Action on Smoking and Health. 2021. *Evidence into Practice: Motivating quitting through behaviour change communications*. [online] Available at: <<https://ash.org.uk/wp-content/uploads/2021/03/Communications-Evidence-Into-Practice.pdf>> [Accessed 9 April 2022].
88. Merck Sharp & Dohme (MSD) UK. 2022. *Do-It-For-Yourself-Campaign-Evaluation-Report*. [online] Available at: <<https://www.msd-uk.com/wp-content/uploads/sites/43/2022/02/Do-It-For-Yourself-Campaign-Evaluation-Report-Jan-2022.pdf>> [Accessed 3 April 2022].
89. Coupe, N., Cotterill, S. and Peters, S., 2018. Tailoring lifestyle interventions to low socio-economic populations: a qualitative study. *BMC Public Health*, 18(1), p.967.
90. Shiffman, S. and Balabanis, M., 1996. Do Drinking and Smoking Go Together?. *Alcohol Health Res World*, 20(2), pp.107–110.
91. Park, E., Gareen, I., Japuntich, S., Lennes, I., Hyland, K., DeMello, S., Sicks, J. and Rigotti, N., 2015. Primary Care Provider-Delivered Smoking Cessation Interventions and Smoking Cessation Among Participants in the National Lung Screening Trial. *JAMA Internal Medicine*, 175(9), pp.1509-1516.
92. Venn, A., Dickinson, A., Murray, R., Jones, L., Li, J., Parrott, S. and McNeill, A., 2016. Effectiveness of a mobile, drop-in stop smoking service in reaching and supporting disadvantaged UK smokers to quit. *Tobacco Control*, 25, pp.33-38.
93. Stewart, M., Kushner, K., Greaves, L., Letourneau, N., Spitzer, D. and Boscoe, M., 2010. Impacts of a support intervention for low-income women who smoke. *Social Science & Medicine*, 71(11), pp.1901-1909.
94. Dieleman, L., van Peet, P. and Vos, H., 2021. Gender differences within the barriers to smoking cessation and the preferences for interventions in primary care a qualitative study using focus groups in The Hague, The Netherlands. *BMJ Open*, 11(1), p.e042623.
95. Smokefree Action. 2017. *Tackling half the difference. Reducing Health Inequalities: A Smokefree Action Coalition briefing for local authorities*. [online] Available at: <<https://smokefreeaction.org.uk/wp-content/uploads/2017/06/BriefingInequalities.pdf>> [Accessed 9 April 2022].
96. Welsh Government. 2018. *An Independent Review of the Provision of Smoking Cessation Services in Wales*. [online] Available at: <<https://gov.wales/sites/default/files/statistics-and-research/2018-12/180612-independent-review-provision-smoking-cessation-services-en.pdf>> [Accessed 9 April 2022].
97. Smith, P., Kasza, K., Hyland, A., Fong, G., Borland, R., Brady, K., Carpenter, M., Hartwell, K., Cummings, K. and McKee, S., 2015. Gender Differences in Medication Use and Cigarette Smoking Cessation: Results From the International Tobacco Control Four Country Survey. *Nicotine & Tobacco Research*, 17(4), pp.463-472.
98. al'Absi, M., Nakajima, M., Allen, S., Lemieux, A. and Hatsukami, D., 2015. Sex Differences in Hormonal Responses to Stress and Smoking Relapse: A Prospective Examination. *Nicotine & Tobacco Research*, 17(4), pp.382-389.
99. Field, J., Duffy, S., Baldwin, D., *et al.* 2015. UK Lung Cancer RCT Pilot Screening Trial: baseline findings from the screening arm provide evidence for the potential implementation of lung cancer screening. *Thorax*, 71(2), pp.161-170.
100. The National Lung Screening Trial Research Team, 2011. Reduced Lung-Cancer Mortality with Low-Dose Computed Tomographic Screening. *New England Journal of Medicine*, 365(5), pp.395-409.

101. van Klaveren, R., Oudkerk, M., Prokop, M., *et al.* 2009. Management of Lung Nodules Detected by Volume CT Scanning. *New England Journal of Medicine*, 361(23), pp.2221-2229.
102. Hirst, Y., Stoffel, S., Baio, G., McGregor, L. and von Wagner, C., 2018. Uptake of the English Bowel (Colorectal) Cancer Screening Programme: an update 5 years after the full roll-out. *European Journal of Cancer*, 103, pp.267-273.
103. Mosquera, I., Mendizabal, N., Martín, U., Bacigalupe, A., Aldasoro, E. and Portillo, I., 2020. Inequalities in participation in colorectal cancer screening programmes: a systematic review. *European Journal of Public Health*, 30(3), pp.558-567.
104. von Wagner, C., Good, A., Wright, D., Rachet, B., Obichere, A., Bloom, S. and Wardle, J., 2009. Inequalities in colorectal cancer screening participation in the first round of the national screening programme in England. *British Journal of Cancer*, 101(S2), pp.S60-S63.
105. McRonald, F., Yadegarfar, G., Baldwin, D., *et al.* 2014. The UK Lung Screen (UKLS): Demographic Profile of First 88,897 Approaches Provides Recommendations for Population Screening. *Cancer Prevention Research*, 7(3), pp.362-371.
106. Crosbie, P., Balata, H., Evison, M., *et al.* 2019. Implementing lung cancer screening: baseline results from a community-based 'Lung Health Check' pilot in deprived areas of Manchester. *Thorax*, 74(4), pp.405-409.
107. Grover, H., Ross, T. and Fuller, E., 2020. Implementation of targeted screening for lung cancer in a high-risk population within routine NHS practice using low-dose computed tomography. *Thorax*, 75(4), pp.348-350.
108. Ali, N., Lifford, K., Carter, B., *et al.* 2015. Barriers to uptake among high-risk individuals declining participation in lung cancer screening: a mixed methods analysis of the UK Lung Cancer Screening (UKLS) trial. *BMJ Open*, 5(7), p.e008254.
109. Patel, D., Akporobaro, A., Chinyanganya, N., Hackshaw, A., Seale, C., Spiro, S. and Griffiths, C., 2012. Attitudes to participation in a lung cancer screening trial: a qualitative study. *Thorax*, 67(5), pp.418-425.
110. Quaipe, S., Marlow, L., McEwen, A., Janes, S. and Wardle, J., 2017. Attitudes towards lung cancer screening in socioeconomically deprived and heavy smoking communities: informing screening communication. *Health Expectations*, 20(4), pp.563-573.
111. Cancer Research UK Lung Screening full report. Available at https://www.cancerresearchuk.org/sites/default/files/cancer_research_uk_lung_screening_report.pdf [Accessed 16/6/22]

Appendix 1. Methods used in this report

Lung cancer incidence and mortality

Statistical analysis was performed on geographical lung cancer incidence and mortality data by health board and local authority. All health boards were included in the statistical tests although Powys THB was subsequently removed from the analysis because there is no cancer treatment provision within this health board. Due to the high number of local authorities close to the average rates for Wales only a small number were included in the statistical analysis (Caerphilly, Merthyr Tydfil, Rhondda Cynon Taf, Powys and Monmouthshire). A separate statistical test was performed using all local authorities within the Aneurin Bevan UHB (Blaenau Gwent, Caerphilly, Monmouthshire, Torfaen and Newport).

First to decide which local authorities to include in the analysis, average lung cancer incidence and mortality from 5 years of data were plotted by local authority including 95% confidence intervals for the data and standard deviation. Data were selected for statistical analysis if the 95% confidence intervals and standard deviation error bars did not overlap with Wales data, based on this 5 local authorities were selected (Caerphilly, Merthyr Tydfil, Rhondda Cynon Taf, Powys and Monmouthshire).

Kruskal–Wallis one-way analysis of variance adjusted for Bonferroni corrections tests were performed on all three chosen datasets (health boards, local authority and Aneurin Bevan local authorities) for lung cancer incidence and mortality separately to establish whether health boards or local authorities were statistically significant from each other. Data were considered statistically different with a P value of less than 0.05 in the pairwise comparisons. Kruskal–Wallis tests were performed using IBM SPSS.

Tumour stage at diagnosis

Statistical analysis was performed to assess the significance of the differences in the proportion of tumours diagnosed at each stage across health boards using the chi-squared test. Data were considered statistically different with a P value of less than 0.05, no significance was reported.

Smoking cessation data

The percentage of the estimated smoking population that made a quit attempt using NHS Help Me Quit services was taken from the StatsWales data 'Welsh resident smokers who made a quit attempt via NHS smoking cessation services, by local health board and cumulative quarters within a financial year' dataset for the period 2019/20 (76). From this the percentage of the estimated smoking population who were CO-validated as successfully quitting 4 weeks post quit date were then calculated using the number of CO-validated smokers from the 'Welsh resident treated smokers who were CO-validated as successfully quitting at 4 weeks, by LHB and cumulative quarters within a financial year' (76) dataset for the same period.

The proportion of quit attempts made by smokers using each NHS Help Me Quit service per health board was calculated using the 'Welsh resident smokers who made a quit attempt via NHS smoking cessation services, by LHB, service and cumulative quarters within a financial year' dataset for the period 2019/20 (76). The percentage of successful quit attempts using

each NHS Help Me Quit service across health boards was then calculated by comparing that data to the ‘Welsh resident treated smokers who were CO-validated as successfully quitting at 4 weeks, by LHB, service and cumulative quarters within a financial year’ (76) dataset for the same period and calculating the percentage of quit attempts that were successful compared to the total quit attempts per service across health boards.

Appendix 2: FOIs used in this report

Health board	2018	2019	2020
Aneurin Bevan UHB	16	11	1
Betsi Cadwaladr UHB	117*	153*	161*
Cwm Taf Morgannwg UHB	88**	53**	63**
Swansea Bay UHB	91	78	54

Appendix Table 1. Freedom of Information (FOI) lung cancer emergency presentation data. Data sourced from FOI requests to all health boards in Wales.

* Betsi Cadwaladr data given for financial years i.e. 2018 in the table equates to the financial year 2018/19.

** Cwm Taf Morgannwg data given from December of one year to November of the following year i.e. 2019 equates to December 2018 – November 2019.

Age group	Male Smoker (%)	Female Smoker (%)
16+	19	19
16-44	21	21
45-64	19	21
65+	13	14

Appendix Table 2. Freedom of Information smoking rates in Cwm Taf Morgannwg UHB. Data sourced from FOI request to the Welsh government Health, social services and population statistics department, for smoking data broken down by health board, age and sex.