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Preface

The WHO Gender and Health Research Series has been developed by the Department of Gender, Women and Health (GWH), with assistance from other WHO departments, in order to address some of the main issues involved in integrating gender considerations into health research. This publication on Gender in Lung Cancer Smoking Research constitutes one of the booklets in this series.

Sex and gender are both important determinants of health. Biological sex and socially-constructed gender interact to produce differential risks and vulnerability to ill health, and differences in health-seeking behaviour and health outcomes for women and men. Despite widespread recognition of these differences, health research has hitherto, more often than not, failed to address both sex and gender adequately.

In applied health research, including the social sciences, the problem has traditionally been viewed as one of rendering and interpreting sex differentials in data analysis and exploring the implications for policies and programmes. However, examining the gender dimensions of a health issue involves much more than this; it requires unravelling how gender roles and norms, differences in access to resources and power, and gender-based discrimination influence male and female health and well-being.

Integrating gender considerations in health research contributes to better science and more focused research, and, consequently, to more effective and efficient health policies and programmes. With these ambitions in mind, the objectives of the gender and research series are to:

- raise awareness of the need to integrate gender in health research;
- provide practical guidance on how to do this; and
- identify policies and mechanisms that can contribute to 'engendering' health research.

The series is aimed at researchers, research coordinators, managers of research institutions, and research funding agencies. It comprises booklets covering both a general introduction to engendering the research process as well as topic-specific issues such as lung cancer, tuberculosis, and mental health. The research series will be extended to other health topics in time.

Each booklet will review the particular health issue from a gender perspective, identify best practices in addressing gender in research and the gaps in gendered research, and make recommendations to address those gaps.

Abstract

This paper reviews the need for a gender-sensitive approach to lung cancer research. Lung cancer is a major cause of premature and avoidable mortality around the world, and although in more developed countries mortality rates are beginning to decrease, especially in men, the number of deaths from lung cancer in less developed countries is steadily increasing. While historically more men than women have died from lung cancer as a result of higher levels of smoking, the male:female mortality ratio is now showing signs of narrowing. Both sex- and gender-linked factors are important in the etiology of lung cancer. However, research into lung cancer needs to address gender more specifically if we are to make progress in reducing both the major risk factor – tobacco use – and the number of deaths from this disease. This paper reviews what is currently known about sex and gender influences on lung cancer, identifies current gaps in gender research on lung cancer and smoking and suggests some directions for the future.

List of abreviations

AMA	American Medical Association
BMI	Body mass index
CDC	Centers for Disease Control and Prevention
COPD	Chronic obstructive pulmonary disease
CT	Computed Tomography
ETS	Environmental tobacco smoke
HRT	Hormone replacement therapy
IARC	International Agency for Research on Cancer
RCT	Randomized control trial
USDHHS	United States Department of Health and Human Sciences

1. Introduction

The "epidemic" of lung cancer mortality has been identified as a major health issue confronting both developed and developing countries. In 2000, over one million people died from lung cancer worldwide; 53% of these deaths occurred in the more developed countries, the remaining 47% in the less developed countries (GLOBOCAN, 2000). Overall, women accounted for just over a quarter of all lung cancer deaths. Estimates suggest that by 2030, all tobacco-related mortality, including lung cancer, will reach around 10 million deaths per year, with the greatest increase coming from the less developed countries (Jha et al., 2002).

Although available data clearly demonstrate differing trends in lung cancer mortality for men and women, it is only in the last few years that there has been an increased awareness of the differences in lung cancer risk associated with both sex (i.e. biological factors) and gender or socially-constructed factors (see Box 1, next page). Despite the growing body of research which explores the ways in which different patterns of lung cancer incidence, mortality and survival might be associated with sex and gender, uncertainties about a number of aspects of the disease and how it differs for men and women remain. At present, many of the research findings in this particular field are suggestive rather than established. This uncertainty reflects, at least in part, the complexity of the factors involved – we must think not only of the roles played by sex and biology, and by gender-related issues, such as access to resources, sexual division of labour and health-seeking behaviour, but also how these factors interact. For example, lung cancer is highly associated with tobacco consumption, but also occurs in those who have never smoked. This implies that external factors, such as environmental tobacco smoke (ETS), need consideration; in addition, research has suggested that exposure to domestic pollution (e.g. emissions from cooking fuels) and to environmental pollution may also have an impact on lung cancer incidence rates.

The objectives of this paper are threefold: firstly, to review what is currently known about sex and gender influences on lung cancer risk; secondly, to offer suggestions as to the kinds of research questions that need still addressing; and thirdly, to identify mechanisms that can contribute to the engendering of lung cancer smoking research.

It is organized as follows: section two outlines the key differences between women and men in terms of their patterns of lung cancer, highlighting what is known about biological factors, sociocultural factors and the interaction between sex and gender.

Section three discusses the role of gender factors in access to health care, including screening, health promotion and smoking cessation support, and treatment for the disease itself. Section four explores the cur-

Box 1

Sex and Gender

Sex is the term used to distinguish men and women on the basis of their biological characteristics. **Gender** on the other hand refers to those distinguishing features that are socially constructed. Gender influences the control men and women have over the determinants of their health, for example, their economic position and social status, and their access to resources. Gender configures both the material and symbolic positions that men and women occupy in the social hierarchy, and shapes the experiences that condition their lives. Gender is a powerful social determinant of health that interacts with other variables such as age, family structure, income, education and social support, and with a variety of behavioural factors.

What then do we mean by gender-sensitive research and why is it considered to be so important? Research that fulfils this objective includes considerations of gender at all levels of the research process, from commissioning and study design through to dissemination of the results. Moreover, sex and gender must be identified as key variables, in all measures, reported separately and the differences discussed (Doyal, 2002).

Health research that is gender sensitive is necessary because sex and gender rank among the key factors, alongside socioeconomic status, ethnicity and age, that determine the health of women and men. Sex and gender affect biological vulnerability, exposure to health risks, experiences of disease and disability, and access to medical care and public health services. Research which is gender in-sensitive may result in study design which is unable to differentiate between women and men in the identification of key findings and their policy implications. Gender-sensitive research, on the other hand, is more likely to lead to improved outcomes in treatment and preventative interventions (Doyal, 2002).

The role of gender in public health is now widely acknowledged and is a core component of many health programmes, both international and national. Sex and gender as determinants of health, and as components of a conceptual framework for health research, are discussed in more detail in the accompanying booklet in this WHO Gender and Health Research Series.

rent knowledge gaps in lung cancer research and suggests directions for future research efforts. This discussion is illustrated with examples of "good practice" in terms of gendered health research; a number of studies, considered to be valuable contributions to the objective of understanding differences between women and men, have been selected from the literature and summarized in a series of boxes. In addition, a set of recommendations for engendering research in relation to tobacco control is included, which can be usefully applied to the wider field of lung cancer research. Section five concludes the paper with a brief summary of the arguments in favour of gender-sensitive research and how this might be developed. There is a degree of urgency about the gender agenda in lung cancer research, which stems from the growing global epidemic of tobacco use and the likelihood of increasing rates of lung cancer among both women and men around the world in the next millennium.

2. Gender issues in lung cancer risk

Data show that more men than women develop lung cancer, and more men than women die from the disease. For both women and men, the single most important risk factor is smoking. Despite the narrowing of the gap between men and women in tobacco use in recent years, the figures for lung cancer mortality still show higher rates for men than women due to the time-lag between exposure to smoking and the development of cancer. However, as the gap in tobacco use continues to narrow, the male:female difference in lung cancer mortality is also expected to decrease further over time. Some research has suggested women may suffer a greater risk of developing lung cancer than men for the same degree of exposure to the various risk factors; however, these findings have yet to be confirmed.

2.1 Differences between women and men in lung cancer incidence, prevalence and mortality

As a disease, lung cancer is one of the most fatal forms of cancer, with very poor prognosis once diagnosed. This is largely a consequence of the natural history of lung cancer, which has a very rapid rate of growth compared with other cancers. Lung cancer is unlikely to be diagnosed opportunistically during the course of other consultations. Screening of an "at risk" population is not currently part of public health policy in any country and despite much debate in the medical literature over the potential of newer methods of screening (Henschke et al., 2001; Grannis, 2002), evaluation of screening has not suggested it would be of significant value (Reich, 2002; Tyczynski, Bray & Parkin, 2003).

Due to the long time-lag between exposure to lung cancer risk factors, such as smoking, and the onset of the disease itself, lung cancer incidence and mortality for women and men tends to reflect prior and long-term exposures to risk. Broadly speaking, patterns of lung cancer incidence and mortality show higher rates of the disease among men than women (see Table 1, next page). In the United States of America (USA), for example, in 2000 the age-adjusted lung cancer incidence rate was 79.7 per 100 000 population for males, compared with a rate of 49.7 per 100 000 for females (SEER, 2003). Similarly, in the United Kingdom, the age-standardized lung cancer incidence rate among males is approximately twice that in women (70.4 per 100 000 population in men and 34.9 per 100 000 population in females in 1999) (Cancer Research UK, 2003).

In many of the more developed countries, the incidence of lung cancer in men has reached a plateau and is now decreasing, whereas the number of new cases in women continues to increase (Bray et al., 2002; CDC, 2002; Jemal et al., 2003). In contrast, in less developed countries male lung cancer incidence is continuing to increase. Although rates of lung can-

Table 1
Global lung cancer incidence and mortality rates, 2000

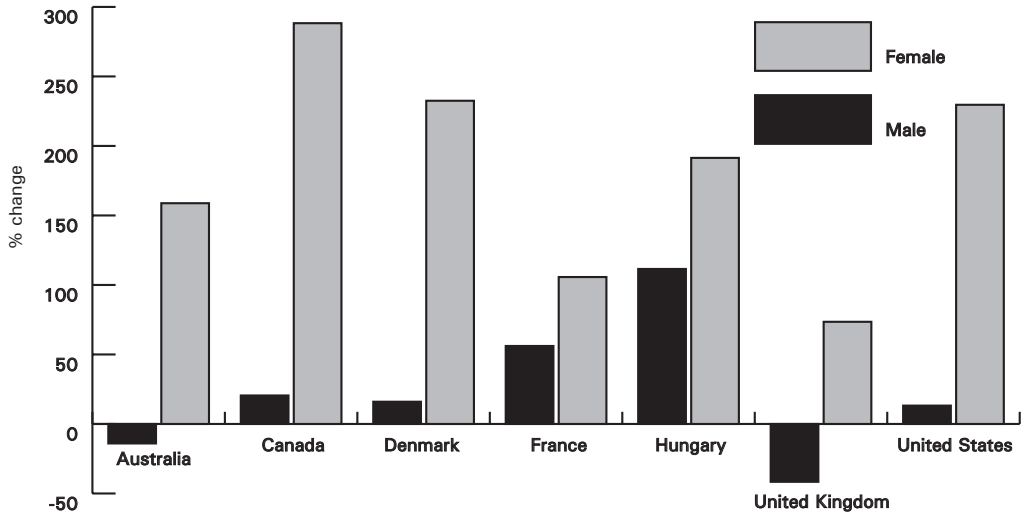
	Cases per 100 000 population [a]		Deaths per 100 000 population [b]	
	Male	Female	Male	Female
World	34.92	11.05	31.43	9.53
More developed countries	55.62	15.62	50.15	13.14
Less developed countries	24.79	8.44	22.02	7.40
Eastern Africa	3.08	2.13	2.84	1.95
Middle Africa	5.65	0.76	5.21	0.70
Northern Africa	15.41	2.76	14.22	2.54
Southern Africa	23.81	7.32	21.98	6.75
Western Africa	2.15	0.35	1.98	0.31
Carribbean	28.76	9.70	26.16	8.70
Central America	22.71	8.44	20.55	7.61
South America	25.28	8.34	22.60	7.41
Northern America	58.20	33.59	52.86	26.95
Eastern Asia	39.41	15.01	33.67	12.68
South-eastern Asia	27.83	9.07	25.68	8.36
South-central Asia	11.61	2.33	10.86	2.15
Western Asia	31.21	4.80	28.85	4.43
Eastern Europe	69.70	8.77	63.12	7.79
Northern Europe	44.32	18.85	45.12	18.07
Southern Europe	58.75	7.95	50.42	6.93
Western Europe	53.21	10.68	48.94	9.18
Australia/ New Zealand	42.10	18.18	36.70	14.80
Melanesia	4.73	2.86	4.37	2.64
Micronesia	51.87	18.6	47.93	17.13
Polynesia	38.36	14.24	35.44	2.10

a Age-standardized rate (world standardized rate).
b Age-standardized rate.
Source: GLOBOCAN 2000. Cancer incidence, mortality and prevalence worldwide. version 1.o I.

cer incidence tend to be relatively low among women in most less developed countries, rates are beginning to increase in some countries (Ezzati & Lopez, 2003).

Due to the low survival rates for lung cancer for both men and women, mortality closely reflects incidence. Consequently, male lung cancer mortality is higher than that of females (Swerdlow et al., 1998; SEER, 2003), again a reflection of the differences in exposure to risk factors, particularly smoking, over the last 50 years (see Table 1, next page). In 2000, the age-adjusted male lung cancer mortality rate in the USA was 76.9 per 100 000 population, compared with a female mortality rate of 41.2 per 100 000 population (SEER, 2003). Mirroring the patterns of incidence, in the United Kingdom the age-standardized lung cancer mortality rate for men at 59.1 per 100 000 population was roughly double that for women (29.5 per 100 000 population) in 2001 (Cancer Research UK, 2003). As in the case of incidence, whereas men's lung cancer mortality rates are decreasing in many developed countries, women's are increasing (Pampel, 2003; SEER, 2003). In several countries, mortality rates have more than doubled in women over a 30-year period, 1968-1998, and even tripled in some, while rates in men over the same period have barely increased overall, and even declined in some countries (See Figure 1 below).

Figure 1: Percentage change in lung cancer mortality rates in selected countries over a 30-year period, 1968-1998



Source: GLOBOCAN 2000. Cancer incidence, mortality and prevalence worldwide. Version 1.o.I.

As the data in Table 2 (page 12) demonstrate, lung cancer prevalence follows much the same pattern as incidence and mortality. Both 1-year and 5-year prevalence is higher in men than in women. Lung cancer is generally more prevalent in developed countries than it is in the less developed countries.

Further differences between men and women are revealed when lung cancer incidence is broken down by histologic type. Women are more frequently diagnosed with adenocarcinoma, whereas men are more likely to have squamous cell carcinomas (Baldini & Strauss, 1997; de Perrot et al., 2000; Siegfried, 2001). These differences are of significance when attempting to understand sex and gender factors in the etiology of lung cancer. Adenocarcinoma, for example, is associated with the major risk factor for lung cancer, tobacco smoke. However, this association is not quite as strong as that for squamous cell cancer, and adenocarcinoma is found more often than other types of cancer in non-smokers (Koyi, Hillerdal & Branden, 2002; Sy et al., 2003). In recent years, adenocarcinoma has increased as a proportion of all lung cancers diagnosed (Blizzard & Dwyer, 2003; Sy et al., 2003). This increase has been associated with the increasing consumption of cigarettes with lower nicotine and tar yields which are also more often smoked by women (Fry, Menck & Winchester, 1996; Levi et al., 1997; Shields, 2002). These shifting patterns in the incidence of the various lung cancer types suggest that different risk and protective factors are operating for men and women (Axelsson & Rylander, 2002; Tewari & Disaia, 2002).

Differentials by geographical region

Within the more developed countries of the world, there are some marked regional variations in lung cancer patterns. The countries in eastern Europe, for example, have the highest rates of male lung cancer mortality; women's lung cancer mortality on the other hand is greatest in northern Europe and in the USA (Tyczynski, Bray & Parkin, 2003). Generally speaking, lung cancer incidence and mortality are lower in developing countries. However, while recent evidence indicates that rates are increasing annually in both men and women, the rate of this increase varies considerably between countries (Ezzati & Lopez, 2003).

The data in Table 1 (page 9) can be used to explore regional differences in the ratio of male to female lung cancer deaths. The widest gap exists in Polynesia, where male deaths outnumber those of women by nearly 17 to 1. A high male:female ratio is also found in eastern Europe, middle Africa, southern Europe and western Asia. The gap between men and women in terms of the number of lung cancer deaths is smallest in east Africa and Melanesia where the male:female ratios are 1.5 and 1.7, respectively. Both of these regions have relatively low lung cancer mortality rates.

Richmond (2003) has distinguished four different stages of the "tobacco epidemic" – the term used to describe the worldwide rapid increase in the use of tobacco and associated mortality from lung cancer – and has characterized these in relation to the level of economic development. Thus countries in the develop-

Table 2
Global lung cancer prevalence, all ages, 2000

	1-year prevalence [a]		5-year prevalence [b]	
	Male	Female	Male	Female
World	361 850	129 859	1 013 529	380 888
More developed countries	211 536	78 338	538 791	212 185
Less developed countries	150 314	51 521	474 738	168 703
Eastern Africa	505	352	1 279	873
Middle Africa	398	77	1 020	209
Northern Africa	2 475	505	6 257	1 288
Southern Africa	1 102	418	2 822	1 091
Western Africa	424	61	1 178	185
Carribbean	1275	523	3 123	1296
Central America	2 688	1 224	6 591	3 044
South America	10 003	4 151	24 792	10 492
Northern America	49 073	38 229	132 630	103 996
Eastern Asia	105 664	38 899	370 777	138 853
South-eastern Asia	14 276	5 786	35 563	14 503
South-central Asia	24 764	5 687	58 269	13 679
Western Asia	6 141	1 047	15 511	2 737
Eastern Europe	58 187	10 826	141 789	29 456
Northern Europe	12 531	6 574	29 294	16 030
Southern Europe	30 690	4 941	78 557	13 258
Western Europe	38 625	9 150	96 659	26 186
Australia/ New Zealand	2 988	1 386	7 305	3 658
Melanesia	16	12	50	35
Micronesia	21	11	55	19
Polynesia	4	<0.5	8	<0.5

a The 1-year prevalence at a fixed-point mid-year is calculated from the number of new cases in 2000, times the probability of surviving for 6 months or longer.

b The 5-year prevalence at a fixed-point mid-year is calculated from the number of new cases in 2000, times the probability of surviving for 4.5 years or longer.

Source: GLOBOCAN 2000. Cancer incidence, mortality and prevalence worldwide, version 1.o I.

ing world in the early stages of the tobacco epidemic (stage 1) have low levels of lung cancer mortality but growing male lung cancer mortality (e.g. Malawi, Nigeria, Swaziland). Countries in stage 2 of the tobacco epidemic (e.g. China, Mexico, The Philippines) have increasing rates of both male and female lung cancer mortality. The more developed countries, typified by Australia, The United Kingdom and the USA, are in stages 3 and 4 of the tobacco epidemic: here smoking is declining in both men and women but while lung cancer mortality rates in men may be relatively static, or even falling, rates in women are continuing to rise as a consequence of their high level of tobacco use in earlier decades.

Although most of countries that are currently in stages 1 and 2 of the epidemic, have a relatively wide male:female gap in lung cancer incidence and mortality, the propensity for female lung cancer rates to rise subsequent to increased levels of tobacco use is a matter of growing public health concern.

Differentials in relation to social diversity

Patterns of lung cancer incidence and mortality in women and men vary significantly in relation to ethnic group and also in relation to social class or income. For example, work by Fry, Menck & Winchester (1996) found a poorer prognosis among black Americans of both sexes diagnosed with lung cancer compared with a white population. Evidence relating to the cause of the poorer prognosis was inconclusive, but the authors suggested that socioeconomic factors, poverty in particular, were likely to be important in this regard. Analysis of lung cancer incidence data for the USA has revealed a bigger gap in mortality between black men and women than between white men and women; in the black population the male:female ratio of lung cancer incidence is 2:1, while in the white population it was only 1.5:1 (SEER, 2003).

Several studies in developed countries have shown that lung cancer mortality is higher among lower income groups (Steenland, Henley & Thun, 2002; Richmond, 2003), a finding that reflects differences in exposure to lung cancer risks, including tobacco, and also the impact of deprivation and poor socioeconomic conditions on lung health (Hart et al., 2001). Nevertheless, gender differences remain, with higher lung cancer mortality in men on lower incomes being a frequently reported outcome (Hart et al., 2001).

2.2 Sex, gender and lung cancer: explaining the differences between women and men

What then are the roles of sex and gender in determining the differences between women and men in their risk of lung cancer morbidity and mortality? Although there is a growing body of research which adds to our understanding of the relative roles played by sex and gender, and which also has begun to suggest ways in which sex and gender may combine to increase risks, the picture remains complex and not fully understood. In particular, there is a need to differentiate between established research findings and those that are more suggestive and also to identify where further research is necessary. Some

studies have suggested that women are more vulnerable to lung cancer than men at the same level of exposure - and it is this that has driven much of the recent research into both sex and gender-linked factors in the etiology of lung cancer. However, this finding is still speculative and controversial. The state of research into the key factors that have been associated with differences in lung cancer patterns between women and men, beginning with those related to gender, is summarized in the following subsections.

Gender-linked factors

Gender-linked factors can be divided into those that affect exposure to risk factors and those that affect access to treatment. In the case of lung cancer the most significant risk factor is smoking, and one of the most pressing research questions, in terms of primary prevention, is how do the determinants of smoking differ between girls and boys, and between women and men? Other avenues of investigation are concerned with differences in smoking behaviour between males and females, and how these might play a role in determining lung cancer risk.

Smoking

Worldwide, there are more male than female current smokers. About 47% of all men and 11% of all women smoke, with men accounting for four-fifths of all smokers (Jha et al., 2002). Table 3 (see next page) presents data on smoking prevalence in selected countries for which data are available and illustrates the wide variation that exits in the ratio of male:female smokers. In India, for example, there are 12 times as many men smokers as women smokers, but in Norway and Sweden the numbers are fairly even. The globally-averaged ratio of male:female smokers is estimated to be 4.3:1 (Jha et al., 2002).

In a number of developed countries, the proportion of women who smoke has in recent years approached and, in some cases overtaken, the proportion of men who smoke – particularly among the younger age groups (WHO, 2001). Taking the USA as a typical example, in 1998, 22% of all women smoked compared with 26% of all men – a narrowing of the sex ratio which reflects the dramatic decrease in the number of male smokers over recent years (USDHHS, 2001). Although rates of smoking are currently low among women in developing countries, some parts of the world, China for example (Tomlinson, 1997), have seen an increase in the numbers of women taking up smoking. According to recent estimates, 60% of Chinese men and 8% of Chinese women smoke (WHO, 1997). The tobacco industry, in its search for new markets, has adopted aggressive marketing techniques in an effort to develop smoking in this sector (Samet & Yoon, 2001; Richmond, 2003).

Current research indicates that male:female differences in smoking prevalence alone does not account for the observed patterns of lung cancer incidence and mortality in women and men, and thus, other factors must be playing a role. It has been suggested that differences in smoking behaviour, i.e. type of tobacco, depth of inhalation and speed of consumption of cigarettes, may provide part of the explanation. Differences between women and men that may be particu-

Table 3

Smoking prevalence[a] in women and men in selected countries

	Male	Female	M: F ratio	Period
India	29	2.4	12.1 : 1	1998-1999
Algeria	43.8	6.6	6.6 : 1	1997-1998
Japan	47.4	11.5	4.1 : 1	2000
Pakistan	36	9	4.0 : 1	1996
Uganda	52	17	3.1 : 1	unknown
Slovakia	41.1	14.7	2.3 :1	1998
Kenya	66.8	31.9	2.1 : 1	unknown
Cuba	48	26.3	1.8 : 1	1995
Spain	39.1	24.6	1.6 : 1	2001
USA	25.7	21	1.2 : 1	2000
Denmark	32	29	1.1 : 1	2000
Norway	31	32	1 : 1	1999-2000
Sweden	17.4	20.4	0.9 : 1	2000-2001
Nauru	49.8	59	0.8 : 1	1994

a Percentage of the relevant population who smoke.

Source: Shafey O, Dolwick S, Guindon GE (eds). *Tobacco control country profiles 2003*. Atlanta, GA, American Cancer Society, 2003.

larly significant in terms of lung cancer risk relate to the type of tobacco used (i.e. composition of the cigarette, cigar or tobacco) and the way in which cigarettes are smoked (i.e. deep or superficial inhalation). Women smokers are more likely to use cigarettes which are lower in tar and nicotine, and which have been labelled as "mild" or "light" by the tobacco industry (Richmond, 2003). Indeed, such labels have been seen by the tobacco industry as having a greater appeal for women, in that they carry associations with weight control. This association has been strengthened by the practice of tobacco companies, not only in their advertising, but also through sponsorship of such activities as beauty pageants in some countries (Christofides, 2002). The WHO Framework Convention on Tobacco Control (WHO, 2003) has called for a global ban on the use of the terms “mild” and “light”, as well as stricter control over such sponsorship and advertising.

Evidence that emerged in the 1990s postulated that one effect of cigarettes with a lower tar and nicotine yield is that smokers tend to draw more heavily on such cigarettes in order to achieve the desired level of nicotine delivery – thus increasing their exposure to tar and other carcinogens (IARC, 2002a; Shields, 2002). Were this to be the case, women smokers could conceivably be at greater risk from the gendered construction of "feminine" cigarettes that have more severe health consequences. However, the interplay of factors here is particularly difficult to unravel. It is important to note that the effect of "low" tar cigarettes on depth of inhalation may be stronger for those who have switched brands; Shields' (2002) research, for instance, looks at people who have attempted to reduce their exposure to lung cancer risk by switching brands, rather than at those who have only ever smoked low tar/nicotine brands.

Although it is generally accepted that smokers may well compensate for a lower tar and nicotine yield by adapting their smoking pattern, the question remains open as to whether this actually results in a higher risk of lung cancer for those who opt to use low tar cigarettes. The Working Group on Tobacco Carcinogenicity of the International Agency for Research on Cancer (IARC) concluded that while changes in cigarette composition in the last 50 years had contributed to reductions in lung cancer risk associated with the number of cigarettes smoked, these same changes may also have affected patterns of cigarette consumption, particularly in terms of how people smoke (IARC, 2002a). A study by Woodward (2001) indicated that smokers who maintain the same smoking pattern and depth of inhalation may be less at risk if they smoke cigarettes with less than 10 mg of tar, compared with those who smoke cigarettes with higher levels of tar.

Other risk factors

Other gender-linked risk factors relevant to the etiology of lung cancer include exposure to environmental tobacco smoke (ETS), fumes and smoke from certain cooking fuels and methods, environmental pollution and employment-related risks in certain industrial settings. Some gender-linked factors may operate to reduce the risk of lung cancer, for example, a diet rich in fruit and vegetables.

However, at present evidence here is limited and inconclusive (IARC, 2002b; 2003).

On the whole, research indicates that environmental factors may affect women more than men, particularly with respect to the risks associated with cooking and with second-hand smoke or ETS. Studies in countries where women are more likely to be lifelong non-smokers have found high levels of lung cancer among non-smoking women associated both with cooking vapours released from the oil used in cooking and with exposure to fumes from coal used in cooking in the home (Gao et al., 1987; Granville et al., 2003; Keohavong et al., 2003; Kleinerman et al., 2002; Metayer et al., 2002; Wen Cheng & Lee, 2003). These are specific gender effects that act to increase women's risks as a result of the sexual division of labour in the home. Studies have also highlighted a role for wider environmental pollution as an additive factor in exposure to lung carcinogens (Hu et al., 2002; Wen Cheng & Lee, 2003). However, recent research would appear to indicate that although environmental risk factors by themselves are significant, it is the combination of the exposure to such risks and genetic differences that add up to produce higher risks of lung cancer for women in these circumstances (Siegfried, 2001).

Evidence relating to the impact of ETS on lung cancer risk has suggested that women may be more at risk because women are more likely to live in a household where a partner smokes than are men (Zang & Wynder, 1996). However, other studies have pointed out that men are more exposed to ETS in the workplace due to: a) higher rates of smoking historically among men, and b) the sexual division of labour in the workplace is such that men are more likely to work in all-male, high-smoking environments. As a result, men may have had a greater lifelong exposure to tobacco smoke (Siegfried, 2001). While some studies have suggested that at similar levels of exposure to ETS, women are more susceptible to lung cancer (Kreuzer et al., 2002), the recent IARC study (2004) suggests risks are similar for women and men.

An increased risk of lung cancer has also been documented among those exposed to occupational lung carcinogens, such as insecticides, pesticides and diesel. Research of this type has tended to focus on the traditional male occupations (Nurminen & Karjalainen, 2001; Brown et al., 2002; Rachtan, 2002; Chan Yeung et al., 2003). Nevertheless, there is some evidence to suggest that there may be differences between women and men in the strength of the risk. For example, a large record-based study of Swedish women and men working in occupations where they would be exposed to diesel emissions reported an increased risk of lung cancer for men (relative to the male population), but not for women (Boffeta et al., 2001). However, this study did not have access to information on smoking.

Sex-linked factors

Sex-linked factors include both those that are related to biological differences between women and men (in particular, the role of reproductive hormones) and those that are related to genetic differences that may play a part in determining vulnerability in the

context of other factors. Sex-linked factors have been identified as being the most likely explanation of women's increased vulnerability to lung cancer at the same level of exposure to risk factors, such as tobacco smoke (Siegfried, 2001).

Research on hormones and lung cancer has indicated that later age at menarche is associated with a decreased risk of lung cancer, as is a longer menstrual cycle length (Gao et al., 1987; Brenner et al., 2003). One study reported differences in histologic cancer type in relation to both the length of the menstrual cycle and number of days of bleeding (Liao et al., 1996). However, Kreuzer et al. (2003), in a case-control study in Germany, found no clear association between lung cancer incidence and reproductive events such as age at menarche, length of menstrual cycle, number of live births or age at menopause, although an association was found with use of exogenous hormones (i.e. oral contraceptives and hormone replacement therapy or HRT). However, other studies, for example, the work of Blackman et al. (2002) failed to demonstrate a link between the use of exogenous hormones and lung cancer.

One of the main problem areas in the research looking at hormonal influences on lung cancer risk is the differentiation of results by smoking status. For example, research into the role of the length of the menstrual cycle suggests that the nature of this impact on individual risk might vary according to smoking status. Seow et al. (2002) found that longer cycles and three or more live births were associated with significantly reduced risks of lung cancer, but only among lifelong non-smokers. It should be noted that this research was carried out in China and studies have not assessed the applicability of these findings to non-Chinese women.

Other research focusing on genetic susceptibility has demonstrated that women are more likely than men to carry genetic mutations that are associated with an increased risk of lung cancer (Dresler et al., 2000; Siegfried, 2001; Stabile et al., 2002; Stabile & Siegfried, 2003; Sy et al., 2003). Studies involving gene expression indicate that hormonal influences on lung disease may affect both the impact of tobacco smoke on the lungs – increasing the risk of carcinogenesis – and the ability of the lungs to recover from, or repair, damage (Haugen, 2002; Stabile et al., 2002). Shields (2002) have suggested that genetic susceptibility is an important element of lung cancer risk and that susceptibility is associated with tobacco use through the metabolism of nicotine and cell repair (Taioli & Wynder, 1994; Siegfried, 2001)

In sum, it is fairly clear then that both gender and sex play a part in shaping lung cancer risk. However, the indications are that, in addition to the independent risks posed by each, there are important interactions between the gender- and sex-linked risk factors that play a further part. In other words, the impact of gendered factors on lung cancer risk may well be mediated by sex-linked factors.

3. Gender issues in access to care

This section outlines the evidence regarding gender differentials in access to health care and in the quality of the care that is available to men and women in relation to lung cancer. Health care issues considered include health promotion and support for smoking cessation, access to screening, diagnosis, treatment for lung cancer, and other factors relating to survival.

3.1 Smoking cessation

Clearly, public health initiatives to reduce smoking are at the centre of lung cancer prevention strategies for both men and women. Preliminary research has suggested that smoking cessation has clearer advantages for women than for men in terms of reduced cancer risk, although this is, at present, a matter of some controversy. Connett et al. (2003), for example, found that women who quit smoking achieved a more significant reduction in chronic obstructive pulmonary disease (COPD), a risk factor for lung cancer, compared with men. However, the authors of this study did not adjust for differences in other risk factors in the study population, such as occupational risk factors for COPD. Research on smoking cessation has also found differences between women and men in their success in stopping smoking, and in the value of nicotine substitutes and other support systems in maintaining cessation. Some studies on smoking cessation have indicated that women give up more often than men but also relapse more often (Borrelli et al., 2001; Perkins, 2001); others suggest there are few differences between men and women in attempts to quit smoking and relapse rates (USDHHS, 2001).

Factors affecting success in quitting smoking are likely to be related to both biology and gender. In terms of the biological or sex-linked factors, there is some evidence to suggest that nicotine affects women and men differently. For example, nicotine withdrawal appears to be more intense for women (Perkins, 2001). Furthermore, whereas some studies indicate that women are more readily addicted to nicotine, nicotine therapy also appears to be less effective for women than men (Tewari & Disaia, 2002). The other sex-linked factor in smoking cessation to emerge from research relates to women of reproductive age, with some studies suggesting that women's success in their attempts to quit smoking may be related to the stage of menstrual cycle when the quit starts (Allen et al., 1999; Pomerleau et al., 2000).

Looking at the gender-related factors in smoking cessation, Borrelli et al. (2001) in a study in the USA found that men who gained weight after stopping smoking were more likely than women who gained weight to relapse in the first three months of a quit. Other studies have shown that women with a higher body mass index (BMI) are more likely to stay quit than women whose BMI is low, perhaps because women who are overweight already are less concerned

about further increases in their weight (Osler et al., 1999). The level of social support provided during attempts to stop smoking has been proposed as a possible factor in smoking cessation. While some research suggests social support is more important for women in cessation attempts (Gritz, Nielsen & Brooks, 1996; USDHHS, 2001), Westmaas, Wild & Ferrence (2002) concluded from their study of 93 men and 117 women that social support may be more closely associated with smoking reduction for men than for women. During an attempt to stop smoking, men's success was associated with a higher self-reported influence of partners, family and friends, whereas for women, increased self-reporting of partner, family and friends' influence was associated with smaller reductions in smoking (Westmaas, Wild & Ferrence, 2002).

Success in smoking cessation is largely governed by two factors: the underlying reasons for tobacco take-up and the reasons for continued use, and again research suggests that both these vary between women and men. Many of the studies of smoking initiation among young people that have been carried out to date indicate that, in developed countries at least, girls may be more likely than boys to continue to smoke after experimentation (Best et al., 2001). Moreover, dieting may be a factor influencing the transition in girls from experimental smoker to more habitual tobacco use (Austin & Gortmaker, 2001).

Research into factors that are considered to be important in continued smoking suggests that women are more likely to remain smokers in response to depression, stress, the desire to control weight and the need for "time out" in caring responsibilities. Men on the other hand are more likely to smoke as part of relaxation. Compared with men, women smoke more often in stressful and "high arousal" situations (Gritz, Nielsen & Brooks, 1996) and are more likely to relapse in the face of stressful life events, particularly health and financial stressors (McKee et al., 2003). Women are also reported as being more likely than men to use tobacco for the sensory aspects of cigarettes (Perkins, 2001) and as a form of self-treatment for feelings of depression and anxiety (Gritz, Nielsen & Brooks, 1996).

Gendered differences between women and men in smoking triggers and associations (in the form of tobacco advertising) also affect the likelihood of successful quits. Tobacco marketing targets women and men smokers in different ways: messages to women tend to link smoking with maturity, confidence, sexual attractiveness and beauty, particularly in developing countries (WHO, 2001). The promotion of "mild" and "light" cigarettes has typically involved associations with weight control (Christofides, 2002; Richmond, 2003). Despite calls for a ban of the use of the terms "light" and "mild", and also for global controls on tobacco advertising, these associations remain important. It is essential that differences between girls/boys and women/men in the factors underlying smoking initiation and continuation are fully understood if primary prevention is to be targeted effectively at both sexes.

Pregnant women, as a group in regular contact with health care providers, and because smoking dur-

ing pregnancy is known to adversely affect fetal and neonatal growth and development, are a key target group for cessation programmes. In terms of the relationship between pregnancy and smoking cessation, factors that are likely to be of particular interest are both biological – related to reproductive factors which affect smoking behaviour (e.g. nausea during the early months) and the use of pharmacological interventions - and gendered – related to social constructions of maternity. The safety of nicotine replacement therapy in pregnancy has not been well studied (Dempsey & Benowitz, 2001). Investigation of the benefits of cessation support from health providers has produced mixed results; nevertheless, it is generally accepted that cessation programmes need to recognize a complex range of factors involved in smoking behaviour during pregnancy, including, for example, the role of stress (Ludman et al., 2000; Bullock et al., 2001).

3.2 Screening and treatment

In comparison with smoking cessation, screening is at present less effective as a means of reducing lung cancer mortality, and for this reason there has been little research on gender differences in the value, or methods, of screening programmes. Although several trials have been carried out (Henschke et al. 2001; Tyczynski, Bray & Parkin, 2003; Wisnivesky et al., 2003), screening programmes for lung cancer have not been widely adopted. Trials have demonstrated that computed tomography (CT) screening may be able to detect Stage I cancers and improve survival rates, but given the poor prognosis of lung cancers and the prohibitive financial and other costs associated with such screening, large-scale screening programmes are not considered to be a cost-effective means of reducing lung cancer mortality. Until such time as studies using randomized-control trial (RCT) methodology become available to prove otherwise, neither mass screening nor the screening of high-risk groups (such as heavy smokers), is likely to be seen as a worthwhile public health strategy (Wisnivesky et al., 2003). Such RCTs would need to consider gender dimensions and the relative value of screening for women in comparison with men.

Similarly, there are few studies that have explored gender differences in diagnosis. In 1991 a report from the American Medical Association (AMA) concluded that women and men did not have equal access to diagnostic studies for lung cancer; research protocols often meant that women were less eligible for inclusion in studies of this type. However, the study did not offer any suggestions for possible reasons for this finding. A later study conducted by Lam et al. (1999) in the USA, which looked at smoking-related changes in lung function and in bronchial epithelial cells, identified differences in pre-invasive lesions and airflow obstruction between men and women. These differences could be of particular significance in the context of screening and diagnostic tests. In Japan, where screening has been introduced, a recent study on the time lapse between screening and diagnosis reported no differences between men and women in the time between screening and the first hospital visit (Kanashiki et al., 2003). These findings may have implications for both diagnosis and the point at which

treatment might start.

Research on differences between women and men in the kind of treatment offered once a diagnosis of lung cancer is made is also thin on the ground, again probably because treatment has little impact on survival. Some research has reported that women's survival rates are higher than those for men, a finding that may, at least in part, be a reflection of the type of lung cancer diagnosed (Alexiou et al., 2002; Radzikowska, Gaz & Roszkowski, 2002; Bremnes et al., 2003). For example, Radzikowska, Gaz & Roszkowski (2002) concluded, on the basis of their multivariate analysis of data on 2875 women and 17 686 men diagnosed with lung cancer in Poland over a five-year period, that advanced stage, non-surgical treatment, age > 50 years at diagnosis and male gender were all significant independent negative prognostic factors.

4. Lung cancer research: knowledge gaps and recommendations for future research

There is now a large number of papers reporting primary research on sex and gender factors in lung cancer and several excellent reviews of the literature in this subject area (see Box 2, next page). Although much of this stems from clinical medicine, there are also studies from the field of health, psychology and from the social sciences. To date, research has to a large extent focused on the biological factors, namely, the reproductive and hormonal differences between women and men, and the part played by genetics, in order to better understand the male:female differences in the patterns of lung cancer mortality. Much less attention has been paid to gender-linked factors that are also likely to play a key role in the etiology of lung cancer. Where research has explored the issue of gender, it has tended to be relation to specific behaviour, that is to say, smoking, although there has been in recent years a growth in efforts to investigate the gender-linked risks associated with exposure to emissions from cooking and domestic fuels in some parts of the world. In addition, some research has been conducted on gender factors associated with exposure to environmental tobacco smoke and to occupational risk factors.

It is now widely acknowledged that gender-sensitive research is essential to the understanding of the role played by various risk factors and their interactions in the etiology of lung cancer. One way of viewing the need for gender-sensitive research is to ask what happens when research is gender in-sensitive. In terms of lung cancer research, empirical information on sex differences in risk is lacking when research does not recognize the gendered nature of some of the risks identified – for example, the fact that women are responsible for domestic work leads, in some countries, to an increased exposure to the risks associated with cooking fuels. When research focuses solely on the biological factors that influence women's risk of lung cancer, the opportunity to highlight and challenge the risks stemming from gendered inequalities is missed. Similarly, research on tobacco use which is gender in-sensitive cannot question underlying motivations for unhealthy behaviour.

In the field of lung cancer research there are now well-established gender effects on lung cancer; there are also a number of findings which, as yet, can only be described as suggestive. Well-established effects include different patterns of smoking for women and men over time, and different levels of exposure to occupational carcinogens and to environmental factors. Box 3 (see page 26) provides a critical review of one of the first papers to explore in depth the differences in risk factors, especially smoking, experienced by women and men.

Box 2

Sex and gender differences in lung cancer

(Stabile & Siegfried, 2003)

Summary

This paper is a review of epidemiological evidence relating to lung cancer and, in particular, examines the differences between women and men. The review largely focuses on research papers from China, the USA and Europe. The paper includes useful data on lung cancer incidence and mortality, as well as smoking. The paper clearly outlines the meaning of sex and gender in the context of lung cancer risk and provides a valuable summary and discussion of research in this field.

What gender issues does the paper cover?

The paper covers in detail the evidence relating to sex-linked factors in lung cancer and as such provides a useful summary of research in this field. The section on gender-linked factors is shorter and focuses on cigarette smoking.

Critique

This paper is highlighted because it distinguishes the different factors that shape lung cancer incidence and mortality patterns with greater clarity than many other reviews of the subject. The summary of sex-linked factors in lung cancer is especially good. However, the paper does not reflect at length on the role of gender in shaping lung cancer risk for women and men.

Many of the gender-linked risk factors are preventable, unlike some of the other risk factors associated with biological differences between men and women where public health initiatives have less to offer. For this reason, while gender-sensitive research is an approach that needs incorporating in all aspects of work in this field, it is most valuable in relation to increasing our understanding of the gender-specific aspects of primary prevention, and of smoking cessation in particular.

Considering the role it plays in lung cancer, the research focus on smoking is only natural. There is a large body of literature on the psychology of smoking and how this relates to self-image, other substance use and self-esteem, especially among younger people. Less attention has been paid on the wider gender picture, that is to say, much of the psychological literature on tobacco use looks at individuals but not at the wider social context of smoking and the structural factors that influence smoking behaviours. Although there are noteworthy exceptions to this (Graham & Blackburn, 1998; Graham & Der, 1999), the majority of studies of this type concentrate on women. What this limited literature suggests is that women and men's smoking behaviour does differ in important ways but that such differences have to be understood across the entire life course and in the context of structural factors such deprivation and disadvantage.

There is also very little research on gender differences in how tobacco is used – how men and women smoke and whether, for example, smoking location and circumstances affect depth of inhalation, length of time taken to smoke a cigarette and length of stub, all factors that may affect risk. Again, these differences are less likely to be individual, and more likely to be associated with structural factors such as paid and unpaid work, caring responsibilities, stress, experience of deprivation and so on. The work of Prescott et al. (1998) is noteworthy in this respect as it one of the few to attempt to explore the nature of gender differences in tobacco use (see Box 4, page 27).

4.1 Current challenges in lung cancer research

Although the volume of research on sex and gender differentials has increased in recent years, there are still significant gaps in our understanding of the ways in which sex- and gender-linked factors relate to lung cancer risk. There are a number of reasons for this. One difficulty is that sex and gender are terms that are not used consistently across all disciplines, or even within disciplines, and also vary over time and place. Despite the existence of a clear delineation in the meaning of these concepts (WHO, 1998), some researchers continue to use "gender" to refer to biological factors and to men and women in a study, rather than restricting the use of the term to reflect socially-constructed differences between women and men (see Box 4, page 27).

The second problem arises because of the complex nature of the interactions between sex and gender in the etiology of lung cancer. A number of recent papers have highlighted the epidemiological difficulties encountered in trying to understand the nature of the risks experienced by

Box 3

Differences in lung cancer risk between men and women: examination of the evidence

Zang &Wynder, 1996

Summary

This paper was one of the first to explore in detail the male:female differences in lung cancer incidence in relation to the major risk factor, smoking. It follows an earlier study by the same authors, but data are analysed and reported in more depth here. The analysis is based on a hospital-based case-control study conducted in the USA, involving 1889 subjects with lung cancer (1108 men, 781 women), and 2070 control subjects (1122 men, 948 women). Using pair-matched controls, adjusted odds ratios (ORs) of lung cancer for men and women were calculated. Results indicated that women with lung cancer were more likely to be never-smokers than men, that men with lung cancer started smoking earlier, reported inhaling more deeply and smoked more cigarettes per day than women with lung cancer. However, dose-response ORs were higher for women than men, even after adjusting for factors such as body mass index (BMI).

What gender issues does the paper cover?

The paper explores differences in lung cancer risk for women and men and analyses the data by gendered factors – smoking history in particular. There is a recognition and attempt to deal with differences between women and men in terms of smoking behaviour – age of smoking initiation, number of cigarettes smoked, and depth of inhalation. The research included detailed and "precisely quantitated" smoking exposures as well as a careful analysis of cancer incidence by histologic type. Differences related to sex and gender such as weight, height and BMI, were also considered.

Critique

This is a ground-breaking paper in the development of research on lung cancer risk for women and men and has been highly influential in shaping subsequent research. Discussion of this paper by other authors since its publication has focused on the way in which data were presented in relation to differences between women and men smokers in the risk of lung cancer. The paper represents an important original contribution to the question of sex-linked differences between women and men in their risk of lung cancer.

Box 4

Mortality in women and men in relation to smoking

Prescott et al., 1998

Summary

In this paper, pooled data from three prospective population studies in Copenhagen are used to compare total and cause-specific mortality in relation to smoking habits. A sample population, comprising more than 30 000 individuals whose date and cause of death was recorded, was monitored between 1964 and 1994. Information was collected from individuals via a self-administered questionnaire on smoking behaviour in never-smokers, ex-smokers, those smoking fewer than 15 cigarettes a day, and those smoking more than 15 cigarettes a day. Data were also collected for those using other forms of tobacco, and on inhalation.

Positive associations were confirmed for both men and women for smoking and lung cancer (together with other causes of death). The authors noted that while relative risks associated with smoking were higher for women in relation to respiratory and vascular disease, there were no differences between women and men in the relative risk of smoking-related cancers. The authors cautiously concluded that although women may be more sensitive than men in terms of some causes of death, lung cancer in not among them.

What gender issues does the paper cover?

The study uses a sufficiently large sample size, in terms of numbers of both men and women, to be able to address questions of difference in relative risk for women and men. The population also includes adequate numbers of female heavy smokers, which is important in the calculation of relative risk for that specific category. It also considers factors such as age at smoking debut and reported inhalation, for women and men, and due to the longitudinal nature of the study, differences in tobacco use over time were also observed. In this respect, the paper recognizes the importance of gender differences in tobacco use.

Critique

The authors use "gender" to refer to women and men, to social differences such as age at smoking debut, and to differences between women and men in parameters that reflect sex as well as gender (all-cause mortality for example). However, the broad use of the word, gender, may be the result of editorial policy of the journal. Like many studies of its type, it suffers from the usual difficulties associated with collecting accurate data from individuals via the means of a self-administered questionnaire. Possible sources of error include memory error and unwillingness to report actual consumption. This paper is based on large-scale survey data with a relatively high response rate (77% for the first examination).

women and men, particularly the additive as opposed to the interactive properties of some risks (Perneger, 2001; Perneger, 2002; Risch & Miller, 2002; Zang, 2002). Thirdly, whereas the type of carcinoma, length of survival and genetic mutation are all variables that may be measured with reasonable scientific accuracy, smoking behaviour, a particularly important factor, is much more difficult to quantify. Many researchers discuss cigarette smoking in terms of "pack years", which is calculated as the number of packs smoked per day times the number of years of smoking. However, we do not know how accurately this measure reflects actual smoking practice, and how the accuracy of the measure might vary for women and men.

We do not fully understand the relative risks for women and men who smoke, or how these risks are modified by other factors (USDHHS, 2001). This is due, in part, to the problems associated with monitoring any self-reported behaviour that is known to have adverse health consequences and, partly to the inherent complexity of the factors that influence smoking behaviour.

4.2 What is required to address the knowledge gaps in lung cancer research?

Much of the research carried out in recent years has focused on explanations of the apparently greater vulnerability of women compared to men at the same level of exposure. There has been less exploration of men's vulnerability to lung cancer – how this varies in response to different risks, how it varies across the life course, and what such variations might tell us about the risks for both men and women. Although there is a continuing need to develop the scientific basis of our understanding of lung cancer risk for women and men, there is also a need to further our understanding of the ways in which such risks are mediated by other forms of diversity, in particular ethnicity and income. Nevertheless, given that the most significant risk factor in lung cancer is known and preventable, priority should be given to interventions to promote and support smoking cessation.

Research methods and methodology

In exploring the impact of different factors on lung cancer risk and on prognosis and experience of the disease, researchers need to identify sex-linked and gender-linked factors consistently. Gender-sensitive research thus implies a requirement for a framework in which sex and gender are clearly conceptualized. In addition, the conceptual framework would need to include explicit recognition of the ways in which sex and gender might interact.

To ensure gender-sensitivity, sufficient numbers of both women and men must be included in research studies so as to allow meaningful analysis, not just from the point of view of generating disaggregated data for women and men but also for specific subgroups of each. The role of hormonal factors in lung cancer means that age and stage in reproductive life course are important considerations for women which need to be taken into account when planning sample size.

Lung cancer research needs to ensure the active involvement of women and men at every stage of the cycle, beginning with the commissioning process, through the development stages, the actual experimental work, and right up to the data analysis and reporting stage (Christofides, 2002). In addition, findings must be analysed and reported in such a way that it is clear who has participated in the research – both as "researched" and as researchers. The way in which participation in the research is arranged, not just the sample design and recruitment, but also the handling of the project itself, should also be transparent.

A useful resource in this context is some work produced by a working group charged with the task of identifying research needs for effective tobacco control (Samet et al., 1998). The recommendations of the working group, which are set out in Table 4 (see page 31), offer a helpful guidance on the principal methods that would be of use in such research, and most significantly, recognize the need to take gender into account in both observational studies and intervention trials.

Smoking and tobacco control

Although the relationship between risk factors and vulnerability to lung cancer may differ for women and men, there is a need to prioritize research that addresses the most significant risk factor – smoking. Key questions are:

- In what ways does smoking behaviour differ for women and men?
- How does smoking behaviour vary during the course of an individual's lifetime and in the context of other responsibilities, such as caring work? (For example, does smoking behaviour, including depth of inhalation and number of puffs taken, alter in relation to responsibilities such as the care of young children?)
- How does smoking behaviour vary by income and ethnicity?

Research in some countries suggests women in particular are likely to underreport smoking due to cultural pressures (Christofides, 2002); in such cases the need for research on smoking behaviour which is aware of these gendered cultural factors, and addresses women appropriately in order to collect accurate information, is especially acute.

The relationship between women's smoking and changes in women's economic and social position is of prime importance, particularly in less developed countries where questions relating to the likely impact of development on gendered differences in smoking behaviour need to be asked. Such research also needs to consider how these influences can be addressed. Research in Europe on women's smoking suggests that associations between social disadvantage, life course influences and smoking are important; here the aim of gender-sensitive research is to guide the development of suitable policies with these influences in mind (Bostock, 2003).

At present, evidence regarding differences in the ways in which tobacco advertising affects women and men is mostly only suggestive, yet the nature of the tobacco industry's

gender-specific approach to selling their goods highlights the need for more work in this field if strategies are to be effective in the future. Questions that should be added to this agenda include those relating to the impact of product placement in films and television.

In terms of the solution to the lung cancer epidemic, primary prevention in relation to smoking is critical. Thus, there is a very definite need for research to evaluate the effectiveness of tobacco control initiatives as they affect men and women, as well as subgroups such as young women and young men, and women and men from different ethnic groups within countries (Greaves & Barr, 2000). Available evidence, albeit rather limited at this point, relating to ethnic differences in smoking initiation and cessation indicates the need for tobacco controls to take account of different patterns of smoking and tobacco use. Tobacco control targets that are appropriate to the stage a country has reached in the tobacco epidemic are also needed, and in this context, research needs to be sensitive to local conditions and knowledge (Christofides, 2002).

Given that smoking cessation is a global public health issue, research on factors that influence smoking cessation is high on the list of priorities. A study by Osler et al. (1999), which looks at unaided smoking cessation in a large sample of smokers in the USA, provides some valuable insights into behavioural and social determinants of smoking cessation (see Box 5, page 32), but more research in this area is still required. More research is also urgently needed to add to current understanding of the biological differences in the effectiveness and value of pharmacological interventions in attempts to quit smoking. This research must also include gender questions about the effectiveness of other forms of support in smoking cessation, and needs to be carried out so as to address questions of differences between groups of women and men, again related to age, income or class and ethnicity.

Finally, there are outstanding questions relating to the impact of employment in the tobacco industry on men and women's use of tobacco. Here too gender factors are likely to be significant, with many women dependent on tobacco cultivation for a livelihood, despite the low wages paid in this sector (Mosoba Mosoba, 2003). The concern here is not confined to the increased risk of smoking initiation, but also the fact that women working in this sector are exposed to occupational health risks arising from the processing of the tobacco. The risks of miscarriages, chest infections, poisoning from chemicals and fumigants, and cancer, for example, are all increased in female tobacco workers (Mosoba Mosoba, 2003).

Screening and treatment

Research into the treatment and screening of lung cancer is generally accorded lower priority than research that adds to the value of primary prevention. Nevertheless, there are some important gaps in our knowledge here that need to be addressed. In terms of diagnosis, more information is needed if we are to be able to establish conclusively the relative values of different diagnostic tests for women and men. With treatment, little is known about the differences that may exist

Table 4

Conducting effective research for global tobacco control: recommended strategies (Source: adapted from Samet et al., 1998)

Survey type	Recommendations	Gender dimension
Observational studies/general surveys	General population studies on tobacco use need to be: ● standardized; ● replicable; ● of sufficient size to provide stable age and sex-specific prevalence estimates; ● conducted every 5 - 10 years; ● flexible enough for more frequent repeats if interventions need evaluation. Surveys of health-care providers and others concerned with public health need to cover: ● smoking among health-care workers; ● evaluation of interventions to reduce smoking in such workers. Children's surveys to cover: ● school-based surveys; ● decisions to smoke; ● impact of tobacco advertising and other forms of promotion.	Sample size critical, as is recruitment and, where cohorts are followed, a means of maintaining contact; may differ for women and men. Gender-specific questions need to be addressed regarding the context of tobacco use, smoking "career" etc. Need to be aware of cultural differences affecting reporting of smoking by women and men. Health-care workers differentiated by gender and professional status – associated links with smoking and cessation need to be considered. Girls and boys' motivations regarding smoking need to be addressed separately.
Observational studies/surveys of adverse health effects	Repeat studies of earlier work to update findings, reinforce message regarding adverse effects. Case-control studies of tobacco related diseases.	Where earlier work has sex/gender gaps, need to build on original methods to enable generation of appropriate data. Case-control but also need to report results separately for women and men.
Intervention studies	All interventions should include an evaluation. Studies should include modification plans to follow ongoing evaluation. Consider relevance of studies across different countries. Differences in nature of nicotine addiction and impact on cessation and other interventions need to be addressed explicitly.	Evaluation needs to consider needs of men and women explicitly and report separately. Studies in other countries may not have separate data on women and men. Gender differences in nicotine impact and addiction need to be considered.

Box 5

Gender and determinants of smoking cessation: a longitudinal study

Osler et al., 1999

Summary

This paper analyses spontaneous unaided smoking cessation in a longitudinal sample population in the USA. The paper claims to be the first to analyse social, behavioural and health-related factors on spontaneous smoking cessation in a study population which includes large numbers of both men and women.

The results reported are based on a sample of 4535 men and 4550 women who were smokers at baseline and attended the first re-examination and 2942 men and 3111 women who also attended the second follow-up examination. Logistic regression was carried out to investigate the determinants of smoking cessation at each interval.

What gender issues does the paper cover?

The analysis presented in the paper revealed that sex and education, and sex and BMI, were key determinants of smoking cessation. The study confirms findings elsewhere that men are more likely to quit smoking after controlling for factors such as age, education and amount smoked, and also that women are more likely to relapse after quitting.

Critique

The strengths of the study lie in its large population size for both men and women. The focus on unaided cessation is also important, in light of other research that suggests there may be differences between women and men in their use of support in smoking cessation. Most other studies report on differences among women and men in aided cessation, largely because this group is more accessible to researchers by virtue of being in regular contact with health care professionals during their attempt to stop smoking. This paper takes a longitudinal approach, which allows the exploration of a range of potential determinants in the absence of health care intervention. The major weakness is the interchangeable use of the terms gender and sex, and the lack of clarity in what these terms mean. However, it is possible that this may be the result of editorial policy of the journal, rather than the fault of the authors.

between women and men in the benefits of different interventions for lung cancer. This is of course a difficult area of research given poor survival rates, and ethical issues would be critical. Similarly, there is little research which evaluates the potential of separate screening for women and men. Screening trials need to consider ways of reporting data that allow disaggregated analysis. Questions that need addressing include whether the potential benefits of screening differ for women and men and whether different criteria for selecting populations for screening exist.

The consequences of lung cancer for those receiving a positive diagnosis is another area where not much work has been done, at least, not in terms of gender. Research which explores gender issues not only in the context of treatment itself (i.e. the speed of diagnosis and appropriate therapies) but also in the context of the delivery of care at all stages of the disease and support for others affected by the diagnosis (i.e. families) is urgently required.

Sex and lung cancer risk: biological factors

A good deal of research has been done already on the role of genetic and reproductive factors in the etiology of lung cancer, but less on the role of hormones. What is required in this area is more research that leads to a position of established findings, as opposed to those that are merely suggestive, especially in terms of the role of hormones in the etiology of lung cancer. Future research also needs to address the additive and/or interactive effects between sex and gender.

More research is also needed on differences between women and men with regard to the impact of protective factors such as diet and exercise. In particular, we need to know whether these are really protective (ongoing research includes the European Prospective Investigation into Cancer and Nutrition) and whether there are sex and/or gender differences in their effects in lung cancer risk. There is some indication that diets rich in vegetables, for example, confer positive benefits and that these may differ for women and men (Axelsson & Rylander, 2002; Chan Yeung et al., 2003). Male:female differences in impact of diet is likely to be related to sex-linked factors, but access to different diets is mediated by gender factors.

5. Conclusion

This paper has reviewed the available evidence as it relates to sex and gender issues in lung cancer and offered some suggestions on how research in this field might be developed towards a more gender-sensitive model. Although there is a considerable body of research that explores differences between women and men in their risk of lung cancer and, to a lesser extent, which looks at survival and differences in smoking behaviour, it is far from complete. Concepts of sex and gender are not consistently applied, and there is often a focus on biological risk factors while truly gender-sensitive research which adds to our understanding of differences between women and men and our understanding of appropriate public health measures remains limited. What we need, therefore, is research which explicitly addresses risk factors, in particular tobacco use, from a gender-sensitive perspective; which devises research protocols, analyses data and reports on findings for women and men separately; and which considers evidence in relation to the potential interaction between sex, or biology, and gender or social structures.

6. References

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7. Additional resources

The following is a list of web sites that provide information about gender issues in lung cancer and related topics that may be of interest to readers.

http://www.tobaccofreekids.org/reports/women/

http://www.who.int/gender/documents/en/Gender_Tobacco_2.pdf

http://www.cdc.gov/tobacco/global/GYTS/globaluse01.htm

http://tc.bmjjournals.com/

http://www.inwat.org/ppp/gendersensitivepolicy.pdf