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Exposure to secondhand smoke among pregnant women in Soweto, South Africa

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2016
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Exposure to secondhand smoke among pregnant women in Soweto, South Africa.

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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Medicine in Obstetrics and Gynaecology.

MMed (O&G)

Johannesburg, July 2016

DECLARATION

I, Joanne Pottow, declare that this research report is my own work.
It is being submitted to the Faculty of Health Sciences for the degree of Master of Medicine in Obstetrics and Gynaecology, at the University of the Witwatersrand, Johannesburg.

It has not been submitted before for any other degree or examination at this or any other University.

15 July 2016

ABSTRACT

Background

Tobacco secondhand smoke (SHS) has long being known for all its negative health effects. This work aimed to determine the SHS exposure rate in the pregnant population of Soweto and to determine their demographic characteristics. We also aimed to explore Soweto pregnant women's knowledge, attitude and practice towards SHS exposure.

Methods

This was a prospective, cross sectional study undertaken at Chris Hani Baragwanath Academic Hospital, a tertiary hospital situated in Soweto. Soweto serves in excess of two million people, with more than 23 000 delivers annually in the hospital. This study used a questionnaire to survey a sample of pregnant women who were post caesarean section.

Results

A total of 100 women were interviewed. Twenty one percent reported to be exposed to SHS at home and 18% of the employed participants reported to be exposed at work.

Forty three percent of the participants lived with a regular smoker and 73% had banned smoking in their house. However, even though the bans had been put in place, smoking still occurred in some of their homes. The demographic characteristics of the SHS-exposed participants compared to the non-exposed participants were similar. There was a statistically significant difference in the number of regular smokers that the participant lived with, with SHS-exposed participants being more likely to live with a regular smoker than with no regular smokers in the house. Ninety two percent of the participants reported they did not think it was appropriate that women smoke, even though some of them had previously been smokers themselves. Ninety one percent of participants were aware that SHS could have a negative effect on their babies while pregnant, and knew about health risks with SHS.

Conclusion

This study showed that in spite of strict anti-tobacco laws, a high percentage of pregnant women reported to be exposed to SHS at home and at work. Most were aware of the health risks of SHS, and tried to ban smoking in their homes.

ACKNOWLEDGEMENTS AND DEDICATION

I would like to express my gratitude to the following people:

Professor EJ Buchmann for his tireless assistance and guidance in the preparation and formation of the study, and for his example of what an exceptional obstetrician should be. Every day, I will strive to be the doctor he has shown us we can be.

I dedicate this research report to my mother. The one who has always believed I could.

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1. INTRODUCTION

The effects of secondhand smoke (SHS) exposure on a pregnant woman's health as well as fetal outcomes are well documented. High-income as well as many lower-income countries have documented their SHS exposure rates, and health effects from smoking and SHS are included in antenatal care programmes. South African pregnant women's exposure rate to SHS is unknown, and data are urgently needed, taking into account the serious adverse effects of SHS.

2. SMOKING

Tobacco is a plant that has been growing as a crop since 6000 BC in the Andes [1] and was originally used in a medicinal capacity [2] being later introduced into Europe by Christopher Columbus [1]. It has been speculated that tobacco initially was used for chewing and later as ‘snuffing’ tobacco (which is to take in powdered tobacco through the nose). Snuffing tubes are among the earliest tobacco artefacts discovered in America [1,2].

Smoking can be defined as the action in which a substance, usually tobacco leaves, is burned and the resulting smoke is inhaled and exhaled [3]. Mainstream smoke is the smoke exhaled by the smoker whereas side-stream smoke is the smoke that emits from the burning cigarette tip [4,5].

Inhaled smoke contains more than 4000 chemicals [6], of which 69 known carcinogens are in mainstream smoke as well as side-stream smoke [3,6]. Tobacco smoke is a complex, dynamic and reactive mixture and is probably the most significant source of toxic chemical exposure and chemically mediated diseases in humans [7].

The perpetual cycle of tobacco use in families was confirmed by Green et al. from Scotland who showed with regard to young smokers that two aspects played a role

namely: social class and parental smoking behaviour. The most likely candidates amongst young people that smoke are those whose parents smoked as well as those from lower social class households [8]. Maternal tobacco use not only is a risk for likely exposure of infants and children to SHS but also it provides a role model for children's tobacco use [8].

A four year prospective study by DiFranza et al. reported that once exposure to nicotine had occurred, relative to the theory that the process of dependence is initiated by the first dose of nicotine, there were few risk factors for smoking which consistently contributed to individual differences in susceptibility to developing dependence or loss of autonomy. Among 217 youths who had inhaled from a cigarette, those feeling either relaxed their first time and those with depressed mood were both predictors for loss of autonomy from cigarettes. Tobacco dependence was predicted by feeling relaxed, familiarity with Joe Camel (a cartoon character used in a controversial advertising campaign by the brand Camel targeting adolescents), novelty seeking, and depressed mood [9].

Pierce et al. performed a longitudinal study on 4500 adolescents looking at the predictive validity of smoking susceptibility. From the sample group, over a four year period, 40% had experimented with smoking and 8% had established a smoking habit. Baseline susceptibility to smoking, defined as the absence of a firm decision not to smoke, was a stronger independent predictor of experimentation than the presence of smokers among either family or the best friend network. However, susceptibility to

becoming an established smoker was increased by the presence of smokers among either family or best friend network [10].

2.1 Smoking, secondhand smoke, and the burden of disease

One of the largest yet theoretically preventable public health threats worldwide is the tobacco smoking epidemic [11]. Tobacco smoking causes an estimated six million deaths per annum, of which 600 000 are the result of non-smokers being exposed to SHS [11], also known as environmental tobacco smoke or passive smoking. It has been postulated that if the tobacco use continues following current trends, the total annual burden could rise to more than eight million deaths by 2030 [11]. Not only is smoking the leading preventable cause of mortality in the United States of America (USA) [3], but according to the Centre for Disease Control, it is also responsible for a threefold increase in early mortality rate for smokers [12].

Groenewald et al. found that smoking creates a large burden of preventable diseases in South Africa [13]. They reported that smoking accounts for 8-9% of deaths and 3.7-4.3% of disability-adjusted life years and is also the third highest risk factor for mortality [13]. Regarding gender distribution they found that three times as many males as females died from smoking and that the largest attributable factor to the development of lung cancer is smoking. However, cardiovascular diseases accounted for the largest proportion of deaths secondary to smoking [13]. Cigarette smoking affects nearly every

organ of the body, resulting in a multitude of diseases and is known to decrease general health among smokers [14, 15]. SHS causes both disease and death in non-smokers, and is a substantial health risk [16]. In 2004, an estimated 53 000 people in Africa died from SHS exposure. Globally, in 2004, 10.9 million disability-adjusted life years, 1.7 million of which were in Africa, were attributed to SHS [17]. In a 2008 study of South African adolescents, 26% were exposed to SHS at home and 34% outside the home [18].

2.2 Smoking and women

Tobacco research conducted in 2008 by Steyn et al. revealed that 11% of South African women were regular smokers [19]. Regarding cancer, in the USA more woman have died from lung cancer as a result of smoking than from breast cancer [12] since the mid-1980s [20]. Between 1960 and 1990, deaths from lung cancer among women increased by more than 400% [20]. Smoking impacts negatively on women's reproductive health and is associated with reduced fertility and early menopause [21].

2.3 Smoking in pregnancy and pregnancy outcomes

Cigarette smoking during pregnancy is a public health issue that has a significant effect not only on maternal health but also on fetal health [22,23]. Smoking during pregnancy

subjects women and their offspring to significant risks. These include preterm birth, low-birthweight infants, stillbirth, and infant mortality [21]. Many women stop smoking when they become aware that they are pregnant, but some do not. Homish et al. studied smoking cessation in the first trimester of pregnancy and what impact the pre-conception social environment has on smoking cessation [23]. They found that women whose partners, but not other household members, were smokers were more likely to smoke during the first trimester [23]. Additionally, women who had a greater proportion of friends [not relatives] who were smokers, and more frequent exposure to SHS, were more likely to smoke [23].

For more than 50 years the association between maternal smoking and preterm birth has been known [24]. In a review of five meta-analyses, Castles et al. looked at the effects of smoking on five pregnancy complications: placenta praevia, abruptio placentae, ectopic pregnancy, preterm premature rupture of the membranes and pre-eclampsia [25]. The analysis showed that smoking during pregnancy is a significant preventable risk factor for ectopic pregnancy, placental abruption, placenta praevia, and prelabour preterm rupture of membranes, while being associated with a reduction in the risk of pre-eclampsia [25].

In a review written in 2005 on the adverse effects of maternal smoking on the human placenta, Zdravkovic et al. found the following. Firstly, maternal smoking impairs placental development as it is shown to change the balance between cytotrophoblast

proliferation and differentiation. This is mediated by smoking-induced changes in molecular pathways associated with oxygen tension, as oxygen is involved in controlling the balance between cytotrophoblast proliferation and differentiation. Hypoxia induces dysregulation of cytotrophoblast expression of von Hippel-Lindau tumor suppressor protein, hypoxia-inducible transcription factors and vascular endothelial growth factor-A [VEGF]. These effects are also found in women exposed to SHS during pregnancy. Secondly, it is hypothesized that placental development is likely affected directly and indirectly as a result of decreased blood flow associated with chronic smoking which causes a pathologically hypoxic environment. [26].

Other deleterious effects have been described. Klesges et al. showed increased calcifications in term placentas of women who smoke, which is thought to be a sign of hypoxic injury [27]. This occurs in order to compensate for the reduced blood flow in the placentas of women who smoke [28]. Additionally, there is evidence that maternal smoking alters other aspects of placental function, including progesterone production [29], estrogen metabolism [30], amino acid transport [31], and the activity of drug-metabolizing enzymes [32] which exacerbates the negative effects of birth weight [33].

The apparent protective effect of smoking on pre-eclampsia is probably counter-balanced by the known harmful effects [25]. Pre-eclampsia is associated with altered maternal vascular function and impaired fetal growth [34]. Maternal smoking enhances expression of VEGF ligands [35], which may explain why mothers who smoke have a lower risk of preeclampsia [26]. Besides the stimulation of proangiogenic factors, such

as VEGF, there may be a reduction in antiangiogenic factors, such as soluble VEGF receptor Flt-1[36]. With regard to maternal vascular function related to smoking's protective effect, two mechanisms have been proposed. Firstly is the exposure to thiocyanate in cigarette smoke, which has a hypotensive effect [37], and secondly an inhibition of thromboxane A2 production and/or increase in levels of prostacyclin [38].

Maternal smoking and its effect on fetal growth cannot be directly assessed therefore birth weight is used even though birth weight is not just a reflection of fetal growth but also a reflection of gestational age and genetic potential. Other studies use intrauterine growth restriction as a reflection of fetal growth. The 2004 Surgeon General's report from the USA concluded that "evidence is sufficient to infer a causal relationship between maternal active smoking and fetal growth restriction and low birth weight" [39]. And the 2006 Surgeon General's report concluded further that "evidence is sufficient to infer a causal relationship between exposure to secondhand smoke and a small reduction in birth weight" [40]. From a South African perspective, in the Birth to Ten study by Steyn et al. on a cohort of 1593 woman living in Soweto and Johannesburg, it was concluded that infants of maternal smokers had significantly lower birth weights (137 g) than non-smokers or snuff users. Second hand smoking did not affect birthweight significantly [41].

Smoking in pregnancy causes early morphological changes of the placenta [42]. This results in a decreased intervillous space volume and surface area of fetal capillaries,

causing less oxygen diffusion across the placenta [43]. The fetus therefore is exposed to chronic hypoxic stress [43]. These factors contribute to a lower birth weight and length, and a smaller head circumference [44]. According to data from a Canadian cohort study by Anderson et al. it is estimated that smoking during pregnancy reduces birth weight by 10–15 grams per cigarette smoked daily [45]. More recently, Wang et al. concluded that the effects of smoking during pregnancy on birth weight and gestational age may even be stronger depending on individual susceptibility [33]. Low birth weight has significant long term effects on future health, including increase risks of coronary heart disease, stroke, hypertension, type 2 diabetes mellitus, insulin resistance, and high low-density lipoprotein levels. Of significance is that in developing countries, these associations seem to be stronger [46].

Bouyer et al. reported a strong association between tobacco use and ectopic pregnancy based on several studies, and this association was confirmed by their own study demonstrating a dose-effect relation. They found that smoking cessation reduced the risk of ectopic pregnancy to an intermediate level between that of current smokers and that of women who have never smoked. Among previous smokers, the time since smoking cessation was not associated with ectopic pregnancy risk [47].

Ananth et al. found that cigarette smoking was associated with a twofold increase in the risk of placental abruption [48]. The relative risk of placental abruption related to smoking is between 1.4 and 2.5 [48, 49]. Smoking has a 2.5 fold increased risk for

severe abruption resulting in fetal death [49]. It has been reported that the risk of abruption increases with the number of cigarettes smoked per day [48] up to a maximum of 10 cigarettes per day after which the risk remains constant [50]. The mechanisms by which maternal smoking increases the risk for abruption remain unclear. Studies have suggested that the mechanism of abruption in smokers is initiated by decidual necrosis at the margin of the placenta [51, 52], or a decreased placental blood flow [53], possibly mediated through changes in production of vasoactive substances such as prostacyclin and nitric oxide [54], or endothelial cell damage [55]. In a case-control study by Kaminsky et al. histological evaluations were carried out on 189 cases of placental abruption [54]. They concluded that placental abruption due to cigarette smoking may be associated with chorionic villous hemorrhage and intervillous thrombosis [54].

In a systematic review published in 2011 by Hackshaw et al. based on 173 687 cases and 11.7 million controls from 127 articles from 1959-2010, the following birth defects are associated with maternal smoking: cardiovascular/heart defects [OR 1.09, 95% confidence interval (CI) 1.02–1.17], musculoskeletal defects [OR 1.16, 95% CI 1.05–1.27], limb reduction defects [OR 1.26, 95% CI 1.15–1.39], missing/extra digits [OR 1.18, 95% CI 0.99–1.41], clubfoot [OR 1.28, 95% CI 1.10–1.47], craniosynostosis [OR 1.33, 95% CI 1.03–1.73], facial defects [OR 1.19, 95% CI 1.06–1.35], eye defects [OR 1.25, 95% CI 1.11-1.40], orofacial clefts [OR 1.28, 95% CI 1.20–1.36], gastrointestinal defects [OR 1.27, 95% CI 1.18–1.36], gastroschisis [OR 1.50, 95% CI 1.28–1.76], anal atresia [OR 1.20, 95% CI 1.06–1.36], hernias [OR 1.40, 95% CI 1.23–1.59] and undescended testes [OR 1.13, 95% CI 1.02–1.25]. They concluded that the above

should be part of public health educational materials to encourage more women to quit before or during pregnancy [56].

2.4 Smoking prevalence and socio-demographics

According to the World Health Organisation, worldwide, there are an estimated 1.1 billion people who smoke and nearly 80% of these smokers live in low-and middle-income countries, where the burden of tobacco-related illness and death is the most [11]. Arnold et al. found that although the overall smoking rates for the American population had decreased since 1992, there has been an increase in smoking among women, teenagers, and poverty stricken adults [22]. Smoking rates tend to also be associated with level of education. A three times higher rate of smoking is reported in women with less than a high school education when compared to with college graduates [14].The highest burden of smoking in females is among low-income women [23]. Arnold et al. also assessed reading level, tobacco knowledge, attitudes, and practices of tobacco use among pregnant adults and adolescent women. They found that the variation in women's knowledge about the effects of smoking and concerns about the health effect of smoking on their babies was related to their reading level. It was found that the higher the reading levels, the more knowledge and greater concern the participant had. Smoking practices and prevalence however were not affected by reading level. Another significant determinant reported was race, with more white women smoking during pregnancy than African Americans (34% vs 8%) [22].

Chomba et al. found in their study of women in Zambia and the Democratic Republic of Congo (DRC) that literate pregnant woman were significantly less likely to live with other tobacco users, live in a home where tobacco smoking was permitted and to have their young children exposed to tobacco smoke indoors, compared to other woman [57]. In developing countries, the prevalence of smoking among women has been low due to strong cultural constraints against women's smoking [58]. About 50% of men in developing countries smoke cigarettes, compared to only 9% of women [15]. Yach et al. reported that smoking related deaths in South Africa need to be explored with an understanding of the underlying demographic and epidemiological changes in the country, which are strongly related to race [59]. The overall smoking rate in South Africa, in 1990, in people over 16 years of age was 31%. The lowest smoking rates were those who had a university education. Smoking rates among African and coloured men were particularly high with a significant increase in smoking in these groups from 1976-1990 [59]. The proportion of women who smoke remained low and remained unchanged among Africans from 1976-1990 [59].

Van Walbeek found that in South Africa, between 1993 and 2002, average cigarette consumption decreased by 26%, attributed to a sharp increase in cigarette retail costs. Smoking prevalence decreased from 32% to 27% of the adult population [60]. He also stated that smoking prevalence had decreased for the majority of the named demographic and socio-economic groups. The most significant decreases were in males, blacks, young adults and low income households. Coloureds, whites, females and high income households did not show a significant decrease in smoking

prevalence. Tobacco use research, conducted in 1998 in South Africa by Steyn et al, showed that among women the rates of cigarette smoking varied with race. Coloured women had a higher rate of smoking [39%] than African women [5.4%] [19].

Regarding smokeless tobacco, worldwide high rates of use have been reported in young people [61], and more so among girls [62]. In South East Asia, smoking among women is reportedly rare, but the use of smokeless tobacco is common [63]. Gupta conducted a study in India of 59 527 lower middle class and lower class women aged 35 years and older, and reported that 57.5% were current users of tobacco, 99.6% of which was smokeless [64]. In South Africa, African woman use smokeless tobacco more frequently than woman of other races [19]. The effects of smokeless tobacco on fetal health are similar to those of cigarette smoking, and appear to be dose dependent [10, 65]. Data from India on smokeless tobacco use in pregnant woman shows a decrease in birth weight. In 1978, Krishna reported that of 1388 singleton births in India, tobacco chewers had babies with a birth weight deficit of 100-200 g, independent of maternal weight, socioeconomic status, and gestational age [66]. More recent work by Mehta et al showed that, of 178 deliveries, there was a 65% incidence of low birth weight babies in smokeless tobacco users, twice as high as that of non-users [67].

2.5 South Africa's health and smoking laws

South Africa has a combination of public health issues. These are a high incidence of heart disease and cancer (non-communicable diseases) as seen in developed

countries, mainly among white and Asian populations, and then disease patterns associated with poverty, such as preventable infectious and nutritional diseases, more prevalent among the African and coloured populations [59]. The tobacco companies have rapidly used the opportunity of the urbanising population and targeted marketing efforts to the latter population groups [59], which now face an additional burden of non-communicable diseases.

Before 1994, a third of all South Africans smoked, excise taxes were low, and there were few tobacco control measures [68]. Van Walbeek reported that increased tobacco tax is a powerful policy tool in reducing cigarette consumption [60]. Between 1970 and 1990, tax rates fell 82%, leading to a 31 percent decrease in retail cigarette prices and a 139 percent increase in cigarette consumption. Then, between 1994 and 1999 excise taxes rose 149 percent, and cigarette prices went up 81 percent, and tobacco consumption went down 21 percent [68].

The South African government implemented the Tobacco Products Control Act of 1993, which regulated smoking in public areas, including workplaces, restaurants, bars and public transport. It also prohibited tobacco sales to people under the age of 16 and regulated tobacco advertising. The amendment to this act in 1999, implemented in 2000, banned all advertising and promotion of tobacco products, including sponsorship as well as distribution of free tobacco products. Yet, despite the South African

government's firm and effective legislative action to discourage tobacco use since 1994, smoking remains a major public health priority [13, 69].

Heloma et al. investigated the impact of national smoke-free workplace legislation on employee exposure to SHS at work, and on employee smoking habits in firms in Finland. They found that exposure to SHS declined considerably one year after the legislation was implemented. Tobacco consumption among smokers diminished, especially amongst less educated employees who showed a proportionally large decrease in smoking. The decrease was especially marked among industrial workers [70].

2.6 SHS and disease

It is only through smokers that the non-smoking population is exposed to SHS and its effects. SHS exposure, a form of involuntary smoking, represents a potentially large public health problem worldwide as evidenced by the severe effects of smoking.

According to the American Cancer Society, SHS is a mixture of two forms of smoke that come from burning tobacco, namely mainstream smoke and side-stream smoke. Side-stream smoke is more carcinogenic than mainstream smoke, and inhaled fresh side-stream cigarette smoke is about four times more toxic per gram total particulate matter

than mainstream cigarette smoke [4, 5]. SHS is classified as a known human carcinogen by the US Environmental Protection Agency, the US National Toxicology Program, and the International Agency for Research on Cancer, a branch of the World Health Organisation, as it contains 7000 chemical compounds, of which 69 are known carcinogenic chemicals [71].

There is substantial evidence that SHS is a major cause of disease in healthy non-smokers [14]. Evidence has accumulated since the 1980s on the effects of passive smoking on lung cancer, coronary heart disease, and chronic obstructive pulmonary disease [69]. Diseases such as lung cancer have been linked to SHS exposure with an increased risk in SHS of 20-30% increased [72]. The cardiovascular system is also significantly affected by SHS exposure, with a 25-30% increased risk of heart disease and a 20-30% increased risk of stroke [73].

A Chinese study has suggested that SHS exposure is linked to a dose-dependent increased risk of severe dementia [74]. While more research is needed to better understand the relationship between SHS, dementia, and mental health [74] there are some studies that have investigated a potential link between SHS exposure and mental health. A US study on SHS exposure and mental health among children and adolescents showed an association between SHS exposure and mental health outcomes [75] but it is unknown as to what the biological or psychological mechanism of association and further research is recommended [75]. In contrast two studies in the

Netherlands found that in non-smoking adults there was no relation between SHS and depression [76].

2.7 SHS, maternal health and pregnancy outcomes

The consequences of SHS on maternal health, pregnancy outcomes and childhood health are well documented. Fertility, conception, survival of the conceptus, and most phases of development studied to date, as well as postnatal health are negatively impacted by maternal tobacco use or exposure [77]. SHS exposure has adverse effects on fertility [14]. Female fertility is affected by altering the balance of hormones that affect oocyte production namely growth hormone, cortisol, luteinizing hormone and prolactin [40].

In an observational study by Hyland et al. 80 762 women participated in the Women's Health Initiative Observational Study and were examined with a cross-sectional analysis to determine the relationship between both active smoking and SHS, and pregnancy outcomes. Never-smoking women with the highest levels of lifetime exposure to SHS had significantly increased estimates of risk for spontaneous abortion, stillbirth and tubal ectopic pregnancy [78]. Leonardi-Bee et al. found that SHS exposure increased the risk of stillbirth by 23% and was linked to a 13% increased risk of congenital birth defects, the detail of the study is provided below. [79]. There is also an increased risk of low birth weight and intrauterine growth restriction [14]. The risk of sudden infant death syndrome

is more than double if the mother is exposed to SHS in pregnancy [14].

A meta-analysis by Salmasi et al. included 76 articles with a total of 48 439 women exposed to SHS and 90 918 unexposed women. This was the first meta-analysis to evaluate the effect of maternal SHS exposure without active maternal smoking on perinatal outcomes. The results showed significantly increased risks of SHS for having a newborn with low birth weight (<2500 g), longer neonates (by 1.75 cm) and a small increased risk of a congenital anomaly (odds ration of 1.17) [80]. No significant differences were found between pregnant women who were and were not exposed to SHS for small-for-gestation babies, spontaneous abortion, caesarean section or Apgar scores at one and five minutes [80]. The meta-analysis could not comment on the association between SHS and perinatal mortality, as no studies examined this outcome. The authors suggested that if SHS does have an effect on perinatal mortality, it is small. [80].

Two further meta-analyses have been published, by Windham et al. [81], which also included maternal active smokers, and by Leonardi-Bee et al. [79], which focused solely on the effects of SHS on in utero growth and duration of gestation [80]. Windham et al., pooling data from 22 articles, found that, of 992 nonsmoking women exposed to SHS for one hour or more per day and paternal smoking, there was an increased risk for low birth weight at term [81]. Leonardi – Bee et al. showed that exposure of non-smoking pregnant women to SHS reduced mean birth weight by 33 g or more, and increased the

risk of birth weight <2500 g by 22%, but had no clear effect on the duration of gestation nor the risk of being small for gestational age [79].

2.8 Effect of SHS on childhood and long-term health

Long term negative effects regarding speech and language skills, intelligence, visual/spatial abilities and behaviour have been shown where pregnant woman were exposed to SHS [82]. Children of non-smoking mothers not exposed to SHS while pregnant performed better with development outcomes mentioned above, than children of mothers exposed to SHS during pregnancy [82]. Children of pregnant women exposed to SHS appear more likely to suffer from attention deficit hyperactivity disorder and conduct disorder [83].

2.9 SHS exposure rates during pregnancy

Various countries have researched SHS exposure rates in their pregnant populations, but most of this research has occurred in developed countries. A variety of methods has been reported in the literature to determine the presence and extent of SHS exposure, including self-reporting and assays of nicotine or cotinine in non-smokers. Cotinine is a major metabolite of nicotine with a longer half-life, and it is considered to be a more accurate measure of total SHS exposure than questionnaire methods [81].

Cotinine levels can be measured in serum, hair or saliva. A study by George et al, that looked at self-reported nicotine exposure and plasma levels of cotinine in early and late pregnancy, found that biochemical methods were superior to self-report when determining exposure levels [84]. Similar findings were reported by Sasaki et al. from Japan [85]. Ideally, SHS exposure in pregnancy should be studied by both self-report and cotinine measurement.

Yet, the systematic review and meta-analysis by Salmasi et al performed a sensitivity analysis comparing the results of birth weight according to maternal self-report of SHS exposure compared to biochemical analyses [80]. This was done because of concerns that self-reporting was unreliable. They found similar decreases in birth weight with maternal self-report of SHS exposure and biochemical analyses, justifying the omission of formal biochemical verification of SHS exposure. Self-reporting may therefore be adequate in determining SHS exposure rates [80].

Bloch et al. carried out a study in nine low- and middle-income countries, using self-reporting methods to determine percentages of homes where smoking was allowed, and SHS exposure rates during pregnancy [58] (Table 2.1). They found that SHS exposure in pregnancy was frequent in a variety of countries. Included in Table 2.1 are additional statistics from other countries including Canada by Salmasi et al. [80], Japan by Sasaki et al. [85] and Torres et al. from the Dominican Republic [86].

Table 2.1. Smoking allowed in homes and SHS exposure rates among pregnant women in 13 countries on four continents.

Continent	Country	% smoking allowed in home	% always/frequently exposed to smoking indoors
Latin America	Argentina	55.3	30.7
Latin America	Uruguay	54.4	26.5
Latin America	Ecuador	26.9	12.9
Latin America	Brazil	36.2	29.6
Latin America	Guatemala	17.4	13.2
Africa	DRC	17.1	8.3
Africa	Zambia	20.5	13.7
Asia	Orissa, India	55.4	10.8
Asia	Karnataka, India	43.3	19.9
Asia	Pakistan	91.6	49.9
Asia	Japan	not reported	63
North America	Dominican republic	76	16
North America	Canada	not reported	22-30

2.10 SHS exposure rates during pregnancy in South Africa

Pregnant women's tobacco use and SHS exposure are current or emerging problems, adding to prevention of improvements in maternal and child health in low- and middle-income countries [58]. What about South Africa? A study of South Africans' tobacco

use in 1998 showed that 28% of non-smokers were exposed to SHS in their homes and 19% were exposed in their workplace [19]. A South African study by Steyn et al. published in 1997, tried to estimate the active and passive smoking exposure in pregnant woman [87]. The study was muticentric, with 394 women from across South Africa [Johannesburg, Cape Town, Port Elizabeth and Durban] from private and public antenatal clinics. These data was collected in 1992. The authors reported that 70% of pregnant women lived with at least one smoker in the house – this seems to fulfil their definition of exposure, as that was the exposure rate to SHS they reported. It was not stated what the criteria were for being considered exposed to SHS. While reporting different figures for passive smoking and exposure to SHS, the authors did not provide detail on how these were differentiated. Their study found that 91% of women thought second hand smoke would have a negative effect on their baby [87].

From reviewing the literature on SHS exposure in pregnancy, no recent research has been done to determine the exposure rate to SHS of South African pregnant women, especially after the introduction of anti-tobacco legislation. With high rates of smoking among South African men of all population groups, SHS exposure among pregnant women is probably not an uncommon occurrence, in homes or in the workplace.

2.11 SHS and preventative interventions

Globally, over a third of all women are estimated to be regularly exposed to SHS [88]. The majority of SHS exposure among reproductive-aged women in low- and middle-income countries happens in the home, where estimates of SHS exposure range from 17.8% in Mexico to 72.3% in Vietnam [89]. Limited data, especially from low and middle income countries, is available for pregnant women. Data from 42 low and middle income countries during 2003-2009 found that SHS exposure rates for pregnant women ranged from 9.3% in the Dominican Republic to 82.9% in Timor-Leste [90]. Risk factors for exposure of pregnant women to smokers in the home included smokers that were living in the household and low level of knowledge of the harms of SHS [91].

It is estimated that 80% or more of pregnant women get antenatal care at least once during their pregnancy [90] and therefore the antenatal visits create an opportunity to screen and counsel pregnant women about SHS. In a systematic review by Tong et al. on clinical interventions to reduce secondhand smoke exposure among pregnant women, 4670 papers from 1990-2013 were reviewed, of which five studies met the inclusion criteria [92]. Clinical interventions included psychosocial and pharmaceutical interventions delivered by either the midwife or obstetrician. One intervention focuses on the partners at home, promoting them to give up smoking through counselling and nicotine patches with follow up phone calls with more counselling. Another intervention is through counselling assisted with video and information booklets, which are repetitively shown and reinforced at the antenatal clinic. The systematic review

concluded that interventions delivered in antenatal care appear to reduce SHS exposure but there were study weaknesses, such as only self-reporting SHS exposure rate reduction with no biochemical confirmation that limited firm conclusions.

The WHO also recommends strong tobacco control policies in public areas and the workplace. These are outlined by WHO Framework Convention on Tobacco Control [FCTC] [93] Public smoking bans have resulted in more homes being smoke free [94] and have effectively reduced SHS exposure among pregnant women. [95, 96].

3. PROBLEM STATEMENT

South Africa, being one of the first countries to put into place strict laws, which limited SHS exposure in public places, should be benefiting from less of a burden of disease from smoking and SHS.

However, what about pregnant women in their homes and in the workplace? If there are high exposure rates, the women and unborn babies involved are at a significant risk for the negative health effects of SHS exposure. It is therefore important to obtain local data on SHS exposure rates in pregnancy, to inform further tobacco control measures with regard to home and workplace exposure by non-smokers. The pregnant population of Soweto, which is served by Chris Hani Baragwanath Maternity Hospital as its pregnancy referral centre, seemed an ideal starting point to explore the extent of SHS exposure in South African pregnant women, to find out how pregnant women regard and deal with smoking in their immediate environment.

4. OBJECTIVES OF THE STUDY

1. To determine Soweto pregnant women's exposure rate to SHS.
2. To describe the demographic characteristics of pregnant women exposed to SHS.
3. To describe, Soweto pregnant women's knowledge, attitudes and practices regarding SHS exposure.

5. METHODS

5.1 Study design

This was a hospital-based, prospective, cross sectional study.

5.2 Study Setting

The study was carried out at Chris Hani Baragwanath Academic Hospital. This is one of the hospitals affiliated with the University of Witwatersrand and is situated in Soweto, South Africa. This hospital has a large number of deliveries (in excess of 23 000 per annum) and as a referral centre it delivers women with high-risk pregnancies, and also low-risk pregnancies transferred from Soweto clinics because of problems arising during antenatal care or in labour. About 10 000 low-risk births are conducted in seven clinics in Soweto, Orange Farm and Lenasia. In accordance with national guidelines on antenatal care, smoking in pregnancy is included in a check-list on the antenatal card, but SHS exposure is not recorded routinely on any document.

5.3 Study population

The study population was women aged 18 years and above who were delivered by primary caesarean section (no previous caesarean section) at Chris Hani Baragwanath Academic Hospital, as representing pregnant women from Soweto. There were two

reasons for choosing women who had primary caesarean sections: 1) they were hospitalized for more than 48 hours after delivery and therefore provided the opportunity for interviews; and 2) women with primary caesarean sections are likely to reflect the overall population of pregnant women throughout Soweto.

The choice of women with primary caesarean section as the sample supposes that the risk of primary caesarean section is not related to SHS exposure. Choosing women after vaginal birth would have sampled mostly high-risk pregnancies having vaginal births in the referral unit at Chris Hani Baragwanath. High-risk pregnant women may modify their exposure to SHS. If the participants had had a previous caesarean section they would have been referred as high-risk for part of their antenatal care and therefore may have had received additional antenatal education including advice regarding smoking. This may have made them more careful in the pregnancy, in terms of self-education, and healthy practices, including avoidance of SHS. Sampling women with primary caesarean sections probably resulted in less selection bias than sampling women with hospital vaginal births. Salmasi et al. found from their meta analyses, there was no significant difference between pregnant women exposed to SHS and those who had a caesarean section (OR 1.10; 95% CI 0.88–1.39, four studies) [80]. Therefore, the data collected from the post-caesarean participants should not be viewed as a limitation of the study and be deemed an acceptable population sample to determine SHS smoke exposure rates.

Given the referral system in Soweto, it is impossible to avoid selection bias in choosing participants for community-based research from users of Chris Hani Baragwanath Academic Hospital for community-based research.

5.4 Inclusion criteria

Women over 18 years of age, who had a primary caesarean section.

5.5 Exclusion criteria

Participants would have previously had a caesarean section. All high risk pregnancies resulting from maternal or fetal causes were excluded. Examples of such exclusions were maternal medical conditions such as hypertension, diabetes, epilepsy, asthma or any other chronic medical conditions. Fetal intrauterine growth restriction diagnosed antenatally was also an exclusion criterion.

5.6 Sampling

Sampling was done in the postnatal caesarean section ward, which consists of 10 cubicles, each with six beds. Women were selected from the cubicles using bed numbers, with the occupants of individual beds selected using a random number list. On days that the researcher was available to collect data, she started at the selected bed

and sampled in ascending number order from that bed until sufficient, eligible women had been selected and agreed to participate, as time permitted.

5.7 Sample size

The researcher interviewed 100 individuals who met the criteria of the study population. This sample size gives 95% confidence intervals at most within ±10% of the observed sample percentage. The study was not powered to test hypotheses on factors associated with SHS exposure.

5.8 Control group

A control group was not applicable to this study.

5.9 Data collection

A prospective questionnaire using a face-to-face interview was conducted on the women who fulfilled the criteria (Appendix 1). A pilot study on 10 women was carried out to test the questionnaire. The researcher personally interviewed each participant. Three women were unable to answer the questions due to language and communication difficulties and declined the interview.

Questions included the pregnant woman's demographic data, use of tobacco products and exposure to SHS in the household and at work. Where possible, questions were

used from pre-existing validated survey tools: Global Tobacco Surveillance System, Tobacco Questions for Surveys, A subset of Key Questions from the Global Adult Tobacco Survey [61], 2000 US National Health Interview Survey [97] and the Smoke-Free Families Screening Form [98]. Questions were also included from the Centers for Disease Control's the health consequences of involuntary exposure to tobacco smoke: a report of the Surgeon General, Atlanta, GA: 2006 [40]. Some of the questions were adapted from the study by Bloch et al [58] to assess pregnant women's use of tobacco and SHS exposure and to allow for direct comparison to the nine developing nations' pregnant women's SHS exposure rate. The two most important questions asked were tobacco use status and SHS exposure.

5.10 Tobacco use status

Participants were asked, "have you ever tried cigarette smoking, even one or two puffs?" If the answer was "yes", the participant was considered to have experimented with cigarettes. Following on from experimentation, questions were asked to determine if the participant was a regular smoker or had ever been a regular smoker. If she answered "yes" to smoking every day or to have smoked more than 100 cigarettes in her lifetime, the participant was considered to have been a regular smoker. To determine if she was a current smoker, the participant was asked if she currently smoked cigarettes every day.

5.11 SHS exposure

All participants were asked, “how often are you indoors and around people who are smoking cigarettes or other types of tobacco products?”. Response options included always, frequently, sometimes, rarely or never. Those that responded with either always or frequently were considered to be exposed to SHS using the self-reporting method.

5.12 Data analysis

The data were entered onto a Microsoft Excel spreadsheet (Appendix 2), and then exported for analysis in Stata 11 software (Statacorp, College Station, Texas, USA). With the assistance of a statistician within the department, descriptive statistics were performed using frequencies with percentages and 95% confidence intervals, means with standard deviations, and medians with ranges where appropriate.

Comparison of characteristics between groups employed the following techniques. For categorical data, the chi-squared test or Fisher’s exact test was used, whichever was appropriate. For continuous (numerical) data, Student’s t-test or Wilcoxon’s ranksum test was used, whichever was appropriate. Statistical significance was accepted at $P<0.05$.

5.13 Ethics

All participants were counselled about the reason for the study. Informed consent was obtained following the patient agreeing to the interview. Each participant was assured that all data collected would remain anonymous on the data sheets (Appendix 3). Permission to conduct the study was sought from the University of the Witwatersrand's Human Research and Ethics Committee (approval number M150503, Appendix 4) The designated representative of the Chief Executive Officer at Chris Hani Baragwanath Academic Hospital was approached for permission to conduct the study. Permission was granted (Appendix 5).

6. RESULTS

6.1 Demographic and obstetric data

These are summarized in Table 6.1. One hundred women participated in the study. Because the denominator is 100, percentages for the whole group of participants are not given. Their mean age was 28.0±6.2 years. The youngest participant was 18 years old and the oldest was 43 years old. Eighteen women were aged 35 or above. The majority of the participants had a formal education in achieving their matriculation but 33% went to school but did not matriculate. One participant reported to have never attended school and another four stated that they were unable to read and write in their home language or English. A large proportion (68%) of participants had their caesarean sections for fetal distress, with another 20 having prolonged labour. Seventy-four women were in stable relationships with their partners, although only nine were married. The median number of people living in the participants' houses was 5.

Table 6.1. Demographic and obstetric data of women interviewed for SHS exposure; n or mean±standard deviation, or median (interquartile range) (n=100).

Age (years)	28.0±6.2
Parity: 1 2 3 e 4	 34 34 24 8
Education (n=99): Did not matriculate Matriculation Tertiary education	 33 66 12
Indication for caesarean section: Fetal distress Poor labour progress Breech presentation Other	 68 20 6 6
Current relationship: Single Stable relationship with partner Married	 26 65 9
Number of persons living in the house	5 (4-7)
Number of children living in the house	2 (1-3)

6.2 History of personal tobacco use

Just under one third (n=32) of the participants had ever tried to smoke. Of these 32 women, four were current smokers. Sixteen women had tried other (smokeless) forms of tobacco, mostly snuff. Two women reported ever smoking cannabis (Table 6.2)

Table 6.2 Personal tobacco use histories of postnatal participants (n=100)

Every tried to smoke	32
Ever smoked daily	15
Have smoked e100 cigarettes in lifetime	13
Current smoker	4
Ever used non-cigarette forms of tobacco	16
Current users of non-cigarette forms of tobacco	2

6.3 Risk of SHS exposure in the home

Seventy three women did not permit smoking in their homes, and 50 of these reported that there was never anyone who smoked in their home. Forty-three participants lived with smoker, 27 of them (63%) with one smoker, and 12 (28%) with two smokers.

The median of number of cigarettes smoked in the house daily was 5. Almost half (n=49) of the participants stated they were sometimes around friends or family who smoked indoors. Eight reported being indoors around smoking individuals “frequently”, and 13 stated that they were “always” exposed to smoking individuals. Twenty participants reported always having someone smoking inside the home, but only 13 stated they were exposed, as the other seven removed themselves from the parts of the house where the smoking occurred to avoid SHS. Therefore, from the definition of SHS given earlier, 21% of the women were exposed to SHS (95% confidence interval 13.5 to 30.3).

Table 6.3 Risk of SHS exposure in the home; n or median (interquartile range) (n=100).

Smoking not allowed in the home	73
Never have anyone smoking in the home	50
Always have someone smoking inside the home	20
Live with a regular smoker	43
Number of smokers living in the house	0 (0-1)
Number of cigarettes smoked by smokers at home per day, estimated by participant	5 (2-10)
“Always” or “frequently” indoors and around people who smoke	21
“Sometimes” indoors and around people who smoke	49

6.4 SHS exposure at the workplace

Only 33% of the participants were found to be employed and the majority (n=30; 91%) of those employed worked indoors. Most of the places of work were found to have designated smoking areas and 27 (82%) reported that smoking was prohibited indoors. Six of the employed women (18%; 95% confidence interval 7.0 to 35.5) reported smoking occurred “frequently” or “always” around them indoors at their workplace.

Table 6.4 SHS exposure at the workplace; n (%) or median (interquartile range) (n=33).

Currently employed	33
Did anyone smoke indoors at work during this pregnancy	6 (18%)
Always or frequently indoors and around people who smoke at work	6 (18%)
Number of cigarettes smoked by smokers at work per day, estimated by participant	6 (5-15)

6.5 Knowledge and attitude towards smoking and SHS

Ninety two of the participants, even though some were smokers themselves, said they did not think it was acceptable for women to smoke and 91 thought that SHS would have an effect on their baby. Seventy three had banned smoking in their house. Ten participants where smoking was not banned mentioned thematically in different ways that they felt as women they were not entitled to institute bans as they were not the owners of the homes.

Table 6.5 Knowledge, attitudes and practices regarding smoking and SHS exposure (n=100)

It is unacceptable for woman to smoke	92
SHS has a negative effect of your baby's health while pregnant	91
Participant has banned smoking in the house	73

6.6 Comparison of pregnant woman exposed to those non-exposed to SHS

The only parameter which showed statistical significance between the exposed and the non-exposed group was the number of regular smokers that lived in the house, all the other parameters examined showed no difference.

Table 6.6 Comparison of women exposed to SHS in pregnancy with those not exposed, with respect to socioeconomic and domestic factors; n(%), median(interquartile range, mean±standard deviation.

	Exposed to SHS (n=21)	Not exposed to SHS (n=79)	P value
Age in years	28.0±6.9	27.9±6.1	0.94
Parity	2 (1-3)	2 (1-3)	0.86
Matriculation achieved	11 (52%)	55 (71%)	0.13
Number of people living in the home	6 (3-9)	5 (4-6)	0.48
Number of children living in the home	2 (1-3)	2 (1-3)	0.90
Number of regular smokers living in the home	1 (1-2)	0 (0-1)	<0.01
Employed	4 (19%)	29 (37%)	0.19

6.7 Comparison of women who banned smoking in their homes to those who did not.

Higher education status was associated with a greater likelihood of the woman banning smoking (P<0.01). If the participants did not live with a regular smoker, they were more

likely to ban smoking in the house as this parameter was also found to be statistical significant.

Table 6.7 Comparison of women who banned smoking in their homes with those who have not, with respect to socioeconomic and domestic factors; n(%), median(interquartile range), mean±standard deviation.

	Smoking not banned (n=27)	Banned smoking (n=73)	P value
Age in years	28.6±6.1	27.7±6.3	0.51
Parity	2 (1-3)	2 (1-3)	0.43
Matriculation achieved	12 (44%)	54 (75%)	<0.01
Number of people living in the home	6 (4-11)	5 (4-6)	0.08
Number of children living in the home	2 (1-4)	2 (1-2)	0.02
Number of regular smokers living in the home	1 (1-2)	0 (0-1)	<0.01
Employed	5 (19%)	28 (38%)	0.09

7. DISCUSSION

It appears that no recent research has been done regarding SHS exposure rates in any South African pregnant population. The study provides a look at South African women from an urban environment, and has shown that SHS exposure is common at home and at work. Exposure levels in the workplace are of some concern, given the South African tobacco regulations in place to protect non-smokers. Most pregnant women are aware of the potentially harmful effects of SHS, and the knowledge of potential harms appears to have translated into banning of smoking in homes by a majority of the women interviewed.

7.1 Demographic and Obstetric data

The participants have a mean age of 28 years. This is aligned with the other nine low-to-middle income countries reviewed by Bloch et al. and specifically the African countries, Zambia and the DRC, where the mean ages were 25 and 27 respectively, but a few years older than those participants in the South African study by Steyn et al. where the mean age was 23. [57,58,87]. The importance with regards to comparison of age in relation to the other studies is to ensure that we are comparing a similar aged population as a younger population may have a higher risk perception due to social awareness of smoking than that of older populations, but also one needs to consider that smoking initiation generally occurs at a younger age resulting in more younger people smoking. In our study there was no statistical significance when comparing age and if smoking was banned in the house or for woman who were exposed to SHS which was unexpected. We expected that the older the participant, the more likely she would be inclined to ban smoking, feeling less peer pressure and having a measure of seniority in the home.

In our study 43% of the participants lived with a regular smoker, and 16% of these participants lived with more than one regular smoker in the house. Living with a regular smoker was not as frequent in other African countries such as Zambia and the DRC [58]. Previous research carried out in South Africa by Steyn et al. in 1992 [87] showed that 50% of women lived with one or two smokers and 19.6% of their participants lived with more than two smoker. The fact that South Africa introduced their anti-smoking

laws after this research may account for this difference, as the authors of the 5th Tobacco Atlas found that smoking prevalence was reduced by 5% within three years in countries with a ban on direct and indirect marketing of cigarettes [15].

7.2 History of personal tobacco use

Steyn et al reported that African women used smokeless tobacco such as snuff more frequently than other population groups but our research showed that participants had tried cigarette smoking more than smokeless tobacco substances. Our cigarette experimentation rate is low, but not as low as in Zambia and the DRC [58].

15% of the participants indicated that they had been regular smokers but only 4% were current smokers. This is substantially lower than what was found in 1992 by Steyn et al. as they reported that 21% of pregnant women smoked. On further analysis of the paper by Steyn et al, the results were collected by race group. Only 3.6% of black women were smokers and considering our research was carried out in Soweto where it was not stated, but in fact all participants were black, this suggests no change in the current smoker figure for black pregnant women. In Zambia and the DRC less than 1% of the women had ever been regular smokers [57].

South African data from this study shows some similarities with African countries and also with other middle-income countries. Each country has its own unique circumstances, and data from one country cannot be readily extrapolated to another,

especially regarding a phenomenon such as smoking in pregnancy, which has multiple social, cultural and economic determinants. This further justifies the need for updated tobacco use research in the country, including the pregnant population with attention to exposure rates and attitudes to SHS.

7.3 Risk of SHS exposure in the home

Smoking was permitted in 27% of homes in our study, which is substantially less than the 76% of homes in countries such as the Dominican Republic (76%), Pakistan (92%), and India (55%) [58]. Other African countries displayed lower rates than those in South Africa, as Zambia had a 20% and the DRC a 17% rate of smoking permitted in the house [57]. From the data we know there are fewer smokers in Africa than compared to the rest of the world and those countries mentioned above, which makes the banning of smoking much more achievable when the prevalence of smoking is so much less in the population. The relatively high rate of banning smoking in the home is however not necessarily from the African population adopting sophisticated strategies to avoid SHS, but rather that there are fewer smokers and therefore instituting a ban is easier. Increases in smoking prevalence in adults as a whole are likely to increase permissibility of smoking in homes and exposure rates to SHS.

From previous research done in South Africa, 50% of women were considered passive smokers, yet exposure was defined if you lived with a smoker, which is not the same definition we used to determine SHS exposure in our study. It is difficult to compare

data when the definition of SHS exposure is not the same as this made lead to incorrect comparisons and conclusions. This was also considered a research limitation as discussed by Tong et al [92]. Clear international guidelines of measuring SHS exposure are needed to provide robust comparable estimates to establish if SHS exposure in pregnancy is indeed reducing or increasing.

Of the 21 participants exposed to SHS, 38% reported that they had banned smoking in their homes. Steyn et al. found in 1992 that 50% of women were classified as passive smokers but looking at the specific race breakdown, 62% of black women reported to be passive smokers. It appears, if the Soweto data reflect national trends, that there has been a substantial reduction in the overall SHS exposure, which could be attributed to the anti-tobacco laws. In spite of this reduction, a 21% current exposure rate in our pregnant population remains unacceptable, and important efforts need to be made to ensure a significant reduction, such interventions are discussed below.

7.4 SHS exposure at the workplace

Eighteen percent of the employed women could be classified as being exposed to SHS at work. With wide confidence intervals because of the small number of employed women, this estimate lacks precision (confidence interval of 95%). Most of the employed participants reported that smoking never occurred indoors as there were strict policies in place regarding smoking in the workplace proving that the majority of formal workplaces have enforced the rules laid down by the Tobacco Control Act of 1993. But the approximately 18% who were exposed suggest a failure in enforcement of health-

promoting legislation. Unfortunately more detail should have been analysed with regards to the type of employment (formal vs informal) as to where the most amount of exposure was occurring.

7.5 Knowledge and attitude regarding smoking and SHS, and potential interventions to reduce SHS exposure

Tong et al. showed that interventions can be used to reduce SHS exposure as well as increase the rate of giving up smoking in the partner. For the pregnant woman, we believe that the simple intervention of education in the ANC by both the obstetrician and the midwife could be introduced in South Africa. Besides face-to-face discussion, information booklets for women to take home and share the information with their partners should be available for all pregnant women. South Africa should capitalise on the long waiting periods in our clinics. This is an ideal opportunity to educate and role-play to a captive audience, ways in which to approach the topic of banning smoking in the home once they get home. Research on the most appropriate local educational tools on pregnancy smoking and SHS exposure is however lacking.

7.6 Comparison of pregnant woman exposed to those non-exposed to SHS

The demographics of the participants who were found to be exposed to SHS were similar to the demographics of the non-exposed group. We could not identify a specific

risk group for SHS exposure, other than living with regular smokers, for which there was, as expected, a higher likelihood of SHS exposure.

7.7 Comparison of woman who banned smoking in their homes to those who did not

The comparison between number of regular smokers in the house and whether smoking was banned was statistically significant in terms of a positive association with fewer regular smokers in the home. It appears from our results that women were unable to, or would not, ban smoking if there were regular smokers in their homes. There was a statistical significance when comparing level of education and banning smoking in the house. The higher the education level, the more likely one is to ban smoking in the home. Chomba et al. found that literate woman were significantly less likely to live with other tobacco users, to live in a home where smoking was allowed and to report that they or their children were exposed to SHS [57]. The most common reason for not banning smoking in homes that participants lived in was that they felt since they were not the owner of the house they did not have the right to ban smoking, especially if the owner of the house was a smoker. Most women felt as if they wishes or requests were ignored as often they reported to have thought about banning smoking and some had even requested it, but were simply ignored and therefore the ban was not maintained. Gender equality and the rights of the African women in the home leads to an important debate, beyond the scope of this study, but which can be explored in additional studies.

The premise that educating a woman in turn educates a community should be considered, in order to empower women to be able to make health-promoting changes within the household, ultimately benefiting the whole family. Banning of smoking indoors should become an accepted norm and this can only be achieved by having buy-in from government, policymakers, men and women.

7.8 Limitations

One of the limitations of the study was a lack of detail in the questionnaire. Participants were asked if they knew if SHS harmed their baby while pregnant, but the knowledge of what damage or what affect the SHS has on them and on their baby was not questioned. The sample size of 100 was perhaps adequate for a pilot study to explore SHS exposure rates, but subgroups were too small to analyse further.

Only one particular race group from one area was investigated within the study and as other studies have showed there are significant differences of tobacco consumption within different racial groups within South Africa. Findings and estimates cannot be extrapolated beyond urban African women who use public health services. The method used for self-reporting of SHS exposure was adequate as most of the questions used were multiple choice question, but we did not verify the information with biochemical cotinine levels. It was also not determined if there was any difference in the exposure to SHS throughout the different pregnancy trimesters. The study had clear but limited objectives. This, combined with the small sample allows only a preliminary

understanding of the magnitude of the potential health problem that SHS presents in South Africa.

8. CONCLUSION

The use of tobacco by pregnant women and the exposure of pregnant woman and their children to SHS flies in the face of many improvements made in maternal and child health. This exploratory study suggests that, at least in South African urban areas, there is significant exposure by pregnant women to SHS, probably higher than that of other African countries. This threatens to add to the burden of tobacco-related illness among some of the most vulnerable groups of people.

Research is needed on feasible methods of communicating SHS risks to the general population and to pregnant women. Such methods may be incorporated into the antenatal care programme to take advantage of the opportunity where the women has actively sought out healthcare and may be more receptive and motivated to make health changes. Lectures, counselling, leaflets and role plays may be appropriate and prove to be effective. Further research should focus on high SHS exposure rates in spite of the firm tobacco controls within South Africa. Results could assist policymakers with regard to where stricter controls should be put into place. As recommended by the WHO, comprehensive smoke-free home legislation should be considered by policymakers in conjunction with the above self-motivation techniques through education to reduce SHS exposure rate. Proposals to reduce smoking overall, such as

raising excise taxes further and banning branding of packaging, and criminal prosecution of illegal cigarette traffickers, should be enacted to reduce cigarette sales further.

Many things, as discussed above, can be put into place in order to reduce SHS exposure. The most reassuring premise is that simple inexpensive tried and tested methods at the antenatal clinic, could put the proverbial wheels in motion towards a zero rate of SHS exposure for pregnant women in South Africa.

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APPENDIX 1

Interview questionnaire

Study No:		Age in years:	
Parity/Gravidity:		Date:	
1. Highest level of education			
No school	Junior school	High School (Grade 12)	Tertiary education
2. Are you able to read and write in your home language or English?			
Yes		No	
3. Indication for caesarean section:			
Fetal distress		Grand Multiparity	
Prolonged labour		Unknown	
Cephalopelvic disproportion			
4. Do you work for pay?			
Yes		No	
5. What is your relationship status?			
Single	Married	Divorced	In a relationship
6. Do you live in Soweto?			
Yes		No	
7. How many people are living in your home?			
How many of the people in your home are children?			

9. How old are the children in the house?			
Under 5	5-17	18 nd over	
10. Have you ever tried cigarette smoking, even one or two puffs?			
Yes		No	
10. Have you ever smoked daily?			
Yes		No	
11. Have you smoked more than 100 cigarettes in your lifetime?			
Yes		No	
12. Do you currently smoke?			
Yes		No	
13. Have you ever tried any other forms of tobacco, besides cigarettes?			
Yes		No	
14. If, yes – which other types?			
15. Have you used this product/s daily?			
Yes		No	
16. Have you used this product more than 100 times in your lifetime?			
Yes		No	
17. Do you currently use other forms of tobacco?			
Yes		No	
18. Is smoking allowed in your house?			
Yes		No	

19. How often does anyone smoke inside your home?			
Always		Frequently	
Sometimes		Rarely	
Never			
20. How many regular smokers live in your house?			
21. How many cigarettes are smoked in your house per day if you live with a regular smoker?			
22. How often are you indoors and around people who are smoking cigarettes or other types of tobacco products?			
Always		Frequently	
Sometimes		Rarely	
Never			
23. Are you employed outside the home?			
Yes		No	
24. Do you currently work?			
Indoor		Outdoor	
Both		Unemployed	
25. During the pregnancy, did anyone smoke in indoor areas where you work?			
Yes		No	
Unknown			
26. How often does anyone smoke inside your place of work?			

Always		Frequently	
Sometimes		Rarely	
Never			
27. How many cigarettes are smoked in your place of work per day by a regular smoker?			
28. Do you think it is acceptable for women in your community to smoke cigarettes, or not?			
Yes		No	
29. Do you know if secondhand smoke could have had any effect on your baby?			
Yes		No	
30. Have you banned smoking in your house?			
Yes		No	
31. If no, why not?			

APPENDIX 2

Data Collection Sheet																						
Question no	Question	Yes	No	Unknown	Other	Always	Frequently	Sometimes	Rarely	Never	No school	Junior school	High school	Tertiary	Fetal distress	Prolonged labour	CPD	Grand Multiparity	under 5	5y - 17y	18 or older
	Age																				
	Parity																				
	Gravitiy																				
1	Highest level of education																				
2	Are you able to read and write in your home language or English																				
3	Indication for caesarean section																				
4	Do you work for pay?																				
5	Are you married or in a relationship?																				
6	Do you live in Soweto?																				
7	How many people are living in your home?																				
8	How many of the people in your home are children?																				
9	How old are the children in the house?																				
10	Have you ever tried cigarette smoking , even one or two puffs?																				
11	Have you ever smoked daily?																				
12	Have you smoked more than 100 cigarettes in your lifetime?																				
13	Do you currently smoke?																				
14	Have you ever tried any other forms of tobacco, besides cigs																				
15	If, yes – which other types?																				
16	Have you used this product/s daily?																				
17	Have you used this product more than 100 times in your lifetime?																				
18	Do you currently use other forms of tobacco?																				
19	Is smoking allowed in your house?																				
20	How often does anyone smoke inside your home?																				
21	How many regular smokers live in your house?																				
22	How many cigarettes are smoked in your house per day if you live with a regular smoker?																				
23	How often are you indoors and around people who are smoking cigarettes or other types of tobacco products?																				
24	Are you employed outside the home?																				
25	Do you currently work?																				
26	During the pregnancy, did anyone smoke in indoor areas where you work?																				
27	How often does anyone smoke inside your place of work?																				
28	How many cigarettes are smoked in your place of work per day by a regular smoker?																				
29	Do you think it is acceptable for women in your community to smoke cigarettes, or not?																				
30	Do you know if secondhand smoke could have had any effect on your baby?																				
31	If you knew that there were harmful effects on your baby would you have avoided second hand smoking?																				
32	Would you have banned smoking in your house?																				

APPENDIX 3

Patient information and consent form

GOOD DAY.

My name is Dr Joanne Pottow. I am a doctor training to be a specialist working at Chris Hani Baragwanath Hospital. I am doing a research project to achieve a master's degree (MMed) with Wits University as part of my training. I am inviting you to participate in this project. This form has information to help you decide if you want to take part. Read it carefully and feel free to ask me or any staff member for assistance.

What is the project about?

We are trying to find out how many women during their pregnancy are around people who smoke either at home or at work. We would also like to ask you how you feel about smoking during pregnancy and how you feel about being around people who smoke while you are pregnant.

Why have I been chosen to participate?

You have been chosen because you have had your first caesarean section and are going to be staying with us for two days. As you know, the antenatal clinic and the other wards are very busy and don't give us the chance to sit down with you and ask you these questions. That is why you have been chosen to participate.

I would like to get some information from your records

I will be asking you a few questions, which will take 10 minutes, with regards to your pregnancy and if you lived with people who smoked. I will also take information from your card.

How do I gain by participating in this project?

You do not gain directly. What I am doing will not affect the way you are treated. This is a research project where we want to find out how to improve care for pregnant woman in the future. Also, you will not receive any reward for agreeing to participate in this project.

Will there be any harm to my baby or me if I participate?

There will not be any harm to you or your baby in any way. The information obtained from asking you the questions will have no effect on any further treatment you will receive from the hospital. Whether or not you take part in this research project is completely your choice.

Could the information obtained in my file end up in the wrong hands?

No. Everything I find out about you is strictly confidential. All the information will go on to my special form that will not have your name or hospital number on. The form contains only a study number and I will be the only person who knows that the study number is yours.

What will happen if I do not want to participate?

You are free to refuse to take part in the project. It will not affect the way you are treated by nurses and doctors here. Even if you sign the consent form to participate, and you change your mind later, you may withdraw from the project.

That is your decision and I respect that.

Who can I speak to if I have a question regarding the research?

If you have any questions about the research, you may ask the doctor or nurse who is attending to you in the hospital, or you can speak to me directly on 0832349107, even

after you have left the hospital. This research has also been approved by the University of the Witwatersrand's Human Research and Ethics Committee. If you have any queries about whether this study is safe or allowed to be done, you may call the committee's secretary, Ms Anisa Keshav, at 0117171234 during working hours.

Thank you

Consent

I agree to participate in this project. Dr Pottow will take information from my card, ask me a series of questions which will not take more than 15 minutes. She will write down the answers on her collection papers.

The forms she uses in this project will not include my name or hospital number. I understand that I am not entitled to any gain for me taking part in the project. I also understand that I may withdraw my consent for participation at any time, even after I have signed this form.

- Participant
- Researcher
- Time
- Date

APPENDIX 4

ETHICS APPROVAL

R14/49 Dr Joanne Poltow

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M150503

NAME: (Principal Investigator)	Dr Joanne Poltow
DEPARTMENT:	Obstetrics and Gynaecology Chris Hani Baragwanath Academic Hospital Department of Obstetrics and Gynaecology, post natal wards
PROJECT TITLE:	Exposure to Secondhand Smoke among Pregnant Women in Soweto, South Africa
DATE CONSIDERED:	29 May 2015
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Professor EJ Buchmann
APPROVED BY:	Professor P Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	27/07/2015

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Secretary in Room 10004, 10th floor, Senate House, University.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with those conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. I agree to submit a yearly progress report.

Poltow — 28/7/15

Principal Investigator Signature — Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX 5

CEO PERMISSION LETTER

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

MEDICAL ADVISORY COMMITTEE

CHRIS HANI BARAGWANATH ACADEMIC HOSPITAL

PERMISSION TO CONDUCT RESEARCH

Date: 26th May 2015

TITLE OF PROJECT:

Exposure to second hand smoke among pregnant woman in Soweto, South Africa.

UNIVERSITY: Witwatersrand

Principal Investigator: Dr J L Pottow

Department: Obstetrics and Gynaecology

Supervisor : Prof E Buchmann

Permission Head Department (where research conducted): Yes

The Medical Advisory Committee recommends that the said research be conducted at Chris Hani Baragwanath Academic Hospital. The CEO / management of Chris Hani Baragwanath Academic Hospital is accordingly informed and the study is subject to:-

- **Permission having been granted by the Committee for Research on Human Subjects of the University of the Witwatersrand.**
- The Hospital will not incur extra costs as a result of the research being conducted on its patients within the hospital
- The MAC will be informed of any serious adverse events as soon as they occur
- Permission is granted for the duration of the Ethics Committee Approval.

Recommended
(On behalf of the MAC)
Date: 26/05/2015

Approved/Not Approved
Hospital Management
Date: 01/06/15

APPENDIX 5

TURNITIN REPORT

MMEDfinalforturnitin.docx

ORIGINALITY REPORT

14%	11%	10%	5%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	www.ncbi.nlm.nih.gov Internet Source	3%
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4	Elwyn Chomba. "Tobacco use and secondhand smoke exposure during pregnancy in two African countries: Zambia and the Democratic Republic of the Congo", Acta Obstetricia Et Gynecologica Scandinavica, 04/2010 Publication	<1%
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