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Health-related quality of life among Macassar residents with persistent lower respiratory symptoms and/or asthma following a sulphur stockpile fire disaster

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DECLARATION

Health-related quality of life among Macassar residents with persistent lower respiratory symptoms and/or asthma following a sulphur stockpile fire disaster

I, Mayuri Rajani, hereby submit my research report for the degree of Masters in Public Health. I Declare that the work on which this research report is based is my original work (except where acknowledgements indicate otherwise), and that neither the whole work nor any apart of it has been, is being, or is to be submitted for another degree in this or any other Technikon or University.

Signed by candidate

Ms Mayuri Rajani **28th September 2010**

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ABSTRACT

Aim: To determine the health-related quality of life (HRQoL) in Macassar residents with persistent lower respiratory symptoms and/or asthma (PLRS and/or asthma), six years after a sulphur stockpile fire disaster.

Methods: A cross-sectional analysis of responses from affected residents was conducted six years after the incident. Information was obtained from a dataset of 4000 respondents to an interviewer-administered questionnaire that included medical history, respiratory symptoms and HRQOL using the Medical Outcomes Study Form 36 (SF-36). The respondents surveyed six years after the fire, provided information for three different time points, prior to, one year and six years after the fire.

Results: A total of 246 records of residents, 74 with PLRS/asthma and 172 without PLRS/asthma were analysed. The mean age of the symptomatic group was 49 (SD:12) years and 47 (SD:13) years in those without symptoms. Approximately 60% of the residents were current and ex-smokers in both groups. A greater proportion were women (61.3%) and 68% of women reported PLRS/asthma. The mean SF-36 scores were significantly lower for the symptomatic group in the Physical Functioning (24 vs. 39), Role Physical (33 vs. 48) and General Health domain (24 vs. 37). Residents with PLRS/asthma, were more likely to experience a significant decline in their Role Physical (OR=1,97; CI 1,09-3,55) and General Health (OR=7,07; CI 2,88-17,35) at year 1 and General Health (OR=3,50; CI 1,39-8,79) at year 6, compared to the asymptomatic group. Residents with co-morbid RUDS (reactive

upper airways dysfunction syndrome) demonstrated even stronger associations for General Health (OR=7,04; CI 1,61-30,7) at year 1 and at year 6 (OR=8.58; CI 1,10-65,02).

Conclusion: This study highlights the long-term adverse impact on HRQOL among residents with lower and upper airways disease following a sulphur stockpile fire disaster.

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SECTION A: PROTOCOL

HEALTH - RELATED QUALITY OF LIFE AMONGST MACASSAR RESIDENTS WITH PERSISTENT LOWER RESPIRATORY SYMPTOMS AND/OR ASTHMA FOLLOWING A SULPHUR STOCKPILE FIRE DISASTER

1. Background

During the anti-apartheid trade sanction era, the South African government found it necessary to stockpile sulphur for the manufacture of sulphuric acid and fertilizers. A chemical company acting as an agent for the government stored the sulphur at its large Somerset West factory in the Western Cape Province. The storing of sulphur started in the late 1960s when the surrounding area was largely unpopulated and underdeveloped.[1] However, the geographic and demographic composition of the area had changed dramatically into a developed area occupied by approximately 30,000 – 40, 000 people at the time of the disaster. On the 16-17 December 1995, 15 000 tons of sulphur ignited, resulting in exposure of high levels of sulphur dioxide (SO_2) vapours amongst the Macassar residents and the surrounding residential and farming areas.[2]

Based on the plume-model concentration of SO_2 levels, the level of SO_2 ranged from 20 – 200ppm in Macassar.[2] Baterman *et al*. estimated that the inhabitants were exposed to high concentrations of smoke and sulphur dioxide, with the main route of exposure being via inhalation of the gaseous SO_2.[3] This kind of chemical disaster, namely the burning of a sulphur stockpile, had not been previously reported. The Macassar disaster was the first of its kind. Approximately 3 000 people had to be evacuated to 'safe areas' and many residents were subjected to conditions of extreme discomfort.[2] Some of the common symptoms

amongst the Macassar residents reported shortly after the catastrophe included coughing (74%), burning eyes (71%), burning nose and throat (67%), burning chest (62%), anxiety and fear (40%), cramps (36%), and vomiting (21%). However, the symptoms one week after the fire were mainly confined to the chest, nose and throat region (90%). The official death toll as a direct result of the fire was reported to be between 10 – 15, but the precise number of deaths remained largely disputed.[3]

The Desai Commission of inquiry was appointed to investigate the circumstances surrounding the Macassar disaster. The Commission concluded that the disaster occurred as a result of negligence on the part of the chemical company. Hence, the Macassar disaster project clinic was established. Many of the residents presented to the clinic for medical assessment and evaluation. The information gathered during this process formed the basis of various different investigations, including this study.

Baatjies study, which assessed "the environmental and host factors associated with persistent lower respiratory symptoms among residents of Macassar six years after being acutely exposed to elevated exposures of SO_2 vapours", was one such study arising from the data collected by the Macassar disaster project clinic.[4] This current study builds on the study by Baatjies and aims to determine the impact of persistent lower respiratory symptoms and asthma on health related quality of life among residents, prior to and after the fire.

2. Literature Review

2.1. Introduction

Quality Of Life (QOL) scale was originally created by American psychologist John Flanagan in the 1970's. QoL refers to an individual's psychological, social and physical wellbeing and how this limits their ability to function in their daily activities. [5] The application of QoL in health care practice and research became steadily important and relevant as our understanding of what optimal health and well-being meant, changed. Thus, health no longer could be defined as mere absence of disease but also the presence of physical, mental, and social wellbeing. [6]

The inclusion of QoL in health care practice and research has given rise to the field of research called Health - Related Quality Of Life (HRQoL). HRQoL refers to, 'the physical, psychological, and social domains of health, seen as distinct areas that are influenced by a person's experiences, beliefs, expectations, and perceptions'. [7] HRQoL research, therefore enables health care practitioners and researchers to assess the impact of different diseases and treatment in a comprehensive manner, by integrating objective functioning and patients' subjective wellbeing. Thus, any two individuals with the same disease process may have very different qualities of life, as their expectations of health, and their ability to cope with the limitations and disability will affect their perceptions of health. [7-9]

2.2. Measuring HRQoL: The SF–36 questionnaire

The Medical Outcomes Study (SF–36) questionnaire is a generic measure as opposed to disease-specific measure, which targets a particular disease process or treatment. A generic

measure can be used in general or specific populations, in order to assess the impact of a range of different diseases or treatment regimes. One of the main features of a generic measure is that it allows for the assessment of many dimensions of health in a comprehensive manner. Furthermore, generic measures can be useful in comparing the findings of different diseases or conditions. [10] SF-36 has been in use since 1990's and is one of the most widely used generic health status measure currently. The SF-36 has been extensively validated in terms of internal consistency and its reliability has been tested among both diseased and general population groups. [11-15] SF-36 is commonly used in studies, in which the primary outcome is HRQoL.

The SF -36 incorporates eight health concepts **(**Table 1). These eight scales Physical Functioning (PF), Role – Physical (RP) and Bodily Pain (BP) Role – Emotional (RE), Mental Health (MH), Vitality (VT), and General Health (GH), Social Functioning (SF), are most widely used in health surveys and are highly affected by disease and treatment.[11] The scores from all the eight scales range from 0 to 100. Scores of the items for the same scales can be aggregated without the need for standardization or item weighting. A high score is consistent with a positive health status. [11] The eight health domains can be further aggregated into two Summary Measures (SM) Physical Component Summary (PCS) and Mental Component Summary (MCS), in order to reduce the number of statistical comparisons, without losing vital information. The following three scales: Physical Functioning, Role – Physical and Bodily Pain correlates highly with physical component and thus contributes largely to the PCS, whereas, Mental Health, Role –Emotional, and Social functioning scales, correlate highly with mental component and contribute to the MCS. The following scales Vitality and General Health correlate with both physical and mental components. [16]

Scale	Number of items	Definition
1. Physical functioning ,	10	Extent to which health interferes with a variety of activities, such as sports, carrying groceries climbing stairs, walking, bathing, dressing
2. Role limitations attributed to physical problems	4	Extent to which health interferes with usual daily activities, such as work, housework, or school
3. Bodily pain	2	Amount of pain and the extent to which bodily pain interferes with both work outside the home and housework
4. General health	5	Overall rating of current health in general
5. Vitality	2	Extent of which one has energy or feeling of tiredness
6. Social functioning	2	Extent to which health interferes with normal social activities, such as visiting with friends during past month
7. Role limitations attributed to emotional problems	3	Extent to which health interferes with usual daily social activities for example, accomplished less than would like to
8. Mental health	5	General mood affect, including depression, anxiety, and psychological well-being

Table 1. Illustrates the classification of items, scales and definition of the items of the SF-36 questionnaire. Adapted from Bousquet et al [17]

2.3. Measuring the HRQoL in asthma

The relationship between impaired psychological, physical and emotional wellbeing amongst asthma sufferers has been well documented. [18] Symptoms of asthma such as shortness of breath, cough, chest tightness and wheeziness can restrict work and leisure activities, cause sleep disruptions and may result in high levels of anxiety and depression. [19, 20] HRQoL is only moderately associated with the traditional outcome measures, such as the forced expiratory volume in one second (FEV_1), bronchial hyper-responsiveness, and medication use. This suggests, that these traditional measures do not adequately capture some important

dimensions of individuals suffering from asthma, which can have a major influence on HRQoL, these include patient's life experiences, socio-economic status, emotional status, health beliefs, perception of symptoms, and expectations of health. [21, 22] Hence, clinicians and researchers require these subjective elements, in order to assess the true impact of asthma on the daily lives of asthma sufferers. Thus, in patients who have a chronic disease such as asthma, measuring the HRQoL, in addition to the traditional measures, provides a more meaningful way to determine the impact of health care, given that asthma can place a severe burden on emotional, physical and social aspects of an individual's life. The main objective of health care therefore, is to ensure that patients experience a satisfactory quality of life. This has lead to a growing preoccupation amongst asthma researchers to measure the impact of asthma on HRQL and since the 1990's there has been a steady increase in availability of literature, in which HRQL is one of the main outcomes .

Studies have consistently shown that asthma diminishes both physical and mental health of asthmatics compared to non-asthmatics, in different study populations, irrespective of the scales, study design, and instruments used. [17, 18, 23-30] In a population-based study, current asthmatics were found to have lower HRQoL scores compared to ex- asthmatics or those who never had asthma. Asthmatics on average, experienced 10 days each month of impaired physical or mental health, which was almost, double the amount of days for non-asthmatics. [23]

2.4. The determinants of HRQoL among people with asthma

2.4.1. Sex/gender

Several epidemiological studies have demonstrated a relationship between sex/gender and HRQoL, in which female asthmatic patients report a poorer HRQL and symptoms compared to male asthmatics. [17, 19, 25, 27, 28, 29] However, most of these studies failed to explore the

reasons for these observed sex/gender differences. Wijnhoven et al highlighted some interesting findings regarding these sex/gender differences. They argue that the gender differences cannot be accounted for by differences in 'objective disease severity', since women had generally higher pulmonary function levels than men, but the differences are likely to be explained by 'subjective disease parameters'. Women reported more severe dyspnoea, and a higher use of medication compared to men in their study. Given that dyspnoea is one of the main symptoms of anxiety disorders, and asthmatic women experience far greater psychological disorders, such as mood and anxiety disorders, compared to men, suggests that women may have more severe asthma in terms of subjective disease parameters.[28] Belloch et al found that dyspnoea was the best predictor of HRQoL in asthmatic women, and this they argue may be related to, the higher anxiety and depression scores in women compared to men. Belloch et al further argue that the contribution of emotional disorders on HRQoL in asthmatic women is further compounded by age. Hence, as women aged, they experience more emotional disorders, thereby further diminishing their HRQoL compared to men. [29]

2.4.2. Age

Studies have shown that age is a contributory factor on HRQoL in asthmatics, but the evidence is inconsistent. Some studies have shown that increasing age results in a decline in HRQoL amongst asthmatics, other studies have found poorer HRQoL scores amongst younger asthmatic patients compared to older asthmatics. Juniper et al found in their study that younger asthmatic patients had significantly diminished HRQoL compared to the older group. This they argue may be due greater adaptation to the limitations caused by asthma amongst the elderly. Thus, elderly asthmatics are less likely to be distressed by their asthma then the younger adults. [19] The findings of Juniper et al are supported by Leynaert et al, who

in a population based study found that young adults rated poorer HRQoL scores in terms of their physical health compared to elderly patients. [31] In contrast, other studies have shown poorer HRQoL scores as age increases in asthmatics. It is argued that among the elderly, co-morbidity may well account for the association between age and poorer HRQoL.[29, 32]

2.4.3 Asthma treatment

Studies that have looked at the impact of treatment guideline (1997 National Institute of Health International asthma guideline) on HRQoL have found significant improvements in the HRQoL amongst asthmatics. A combined treatment of Inhaled corticosteroid with budesonide, fluticasone, and becclomethasone was found to improve HRQol amongstasthmatics.[33, 34] Treatment with Beta- antagonists was also found to improve HRQoL.[35, 36] In general, asthma patients treated according to guideline treatment, have been found to have far superior HRQoL scores, compared to patients not treated according to the treatment guidelines.[37]

However, a recent study found that despite improvements in the overall HRQoL of asthma patients on guideline treatment, the psychological well-being of these patients remained significantly diminished due to high levels of anxiety and depression amongst asthmatics.[38]

2.4.4. Smoking status

There appears to be a significant association between smoking status and HRQoL in individuals with asthma. Current smokers experience a far greater decline in their HRQoL compared to non- smokers or former smokers.[39, 40] However, it is still unclear, the mechanism by which smoking influences HRQoL amongst asthmatics. One possible explanation is that

smoking increases respiratory symptoms, which is found to impair HRQoL amongst asthmatics. [40]

2.4.5. Socioeconomic status

Apter et al, found a strong association between individual level SES (education level, household income, occupational status and type of health insurance) and HRQoL. The study demonstrated that individuals with lower education, who were unemployed and had lower household income, had poorer asthma control, which contributed significantly to impaired HRQoL in both the AQLQ and Physical Component Summary (PCS) of the SF-36.[41]

However, the sample size was relatively small (n=50) and therefore raises questions about the validity of the findings. Further studies are required in order to determine the relationship between socioeconomic status and HRQoL amongst asthmatics.

2.2.6. Asthma with co-morbidity

Very few studies have examined the impact of co-morbidity on HRQoL amongst asthmatics in any detail. Wijnhoven et al is one of few studies, which examines in detail, the impact of co-morbidity on HRQoL in asthmatic patients, using both the generic and the disease- specific questionnaire. The findings suggest that co-morbidity is an important determinant in both disease-specific and generic HRQoL among asthmatics. Most notably, the presence of more than one co-morbidity decreases the HRQoL in asthmatics significantly. In addition, the study demonstrated that asthmatics with cardiac history and hypertension had poorer disease-specific HRQoL scores compared to generic HRQoL scores. Asthmatics with musculoskeletal disorders had the poorest generic HRQoL scores. The impact of diabetes and other chronic diseases were not significant; however, this may be due to the small sample size in this group.[24]

One of the limitations of Wijnhoven et al's study is that it may have underestimated, the association between co-morbidity and HRQoL in asthmatics, given that the sample was selected from general practice, where they are likely to have a relatively mild form of the disease as opposed to outpatients clinics or hospitals, where patients are likely to suffer from more severe form of the diseases.[24] Furthermore, Wijnhoven et al, did not examine the contribution of psychological disorders in asthmatics. Asthmatic patients are known to report higher rates of anxiety and depression compared to the general population.[18] Moreover, studies have shown the adverse effect of depression and anxiety on HRQoL in asthmatics.[25,28,29] Depression is found to profoundly impact on both physical and mental health domains in asthmatics. Asthmatics with more depressive symptoms rate significantly lower HRQoL compared to asthmatics with less depressive symptoms.[42]

Nevertheless, despite its limitations, Wijnhoven et al's study highlights some important considerations for asthma studies measuring HRQoL outcomes. Firstly, the importance of including co-morbidity in studies on HRQoL. Secondly, the importance of using both the asthma- specific and generic questionnaires in combination, as this will serve to strengthen the study and its findings.

2.5. The impact of other chronic diseases on HRQoL

Intervention of modern medicine has resulted in an increasing ageing population suffering from chronic diseases, which may adversely affect their HRQoL. Studies have shown the adverse impact of co-morbidity on HRQoL amongst those suffering from chronic diseases, particularly amongst the elderly. Thus, co –morbidity with asthma may influence the way in

which, an individual with asthma may rate their HRQoL and hence, distort the true relationship between asthma and HRQoL.

2.5.1. Hypertension and HRQoL

Despite the availability of literature, which attempts to describe the relationship between hypertension and HRQoL, it is still unclear whether hypertension is associated with HRQoL. Some studies have shown the adverse affect of hypertension on HRQoL, whereas other studies have shown no associations between hypertension and HRQoL.

A recent study in a Chinese general population, Wang et al, found that hypertensive people had lower HRQoL compared to normotensives. Hypertensive patients were most affected by physical health and least affected by the mental health dimension. Furthermore, hypertensive patients with co-morbidity had lower HRQoL scores compared to hypertensive patients without co-morbidity. [43] Previous studies in western populations, have shown similar findings.[44-46] Wagner and Strogatz, however found in their study, that individuals diagnosed with hypertension, had a lower HRQoL scores compared to those who where hypertensive, but were unaware of their diagnosis. Thus, concluding that labelling patients with hypertension and/or the treatment highly influenced their rating of HRQoL as opposed to the disease itself. [47] These findings are consistent with other studies. [48, 49]

2.5.2. Diabetes mellitus and HRQoL

Studies which have focused on HRQoL amongst diabetics in western populations have shown the adverse effects of diabetes on HRQoL .[50-53] Diabetes mellitus was found to significantly diminish a patient's physical health and functional health. In addition, the presence of co-morbidity, and in particular, cardiovascular conditions, further decreases functional health in

diabetics. Surprisingly, diabetics were not found to be negatively affected, in terms of their mental health compared to non-diabetic patients.[50] In contrast, a recent study amongst Chinese patients in a primary care setting, showed a positive impact on HRQoL amongst diabetics compared to non–diabetics. The authors argue that this discrepancy may lie in the different cultural adaptation to diseases between Western and Chinese populations, given that Chinese culture stresses the importance of endurance and acceptance to one's fate. The authors go on to stress that further research is needed in this area to confirm their findings. [54]

2.5.3. Cardiac diseases and HRQoL

Studies have shown that cardiovascular conditions adversely affect HRQoL in both physical health and mental health domains. [55-57] A recent study found that patients with congestive heart failure experienced a far greater decline in their HRQoL compared to other serious common chronic diseases and other cardiac conditions. [55, 56] Acute Myocardial Infarction and angina were also found to severely impair HRQoL. Furthermore, cardiac patients with co-morbidity such as respiratory diseases, anxiety and depression rated significantly lower HRQoL compared to cardiac patients without co-morbidity .[57]

2.5.4. Psychological disorders and HRQoL

Studies have found that psychological disorders profoundly affect HRQoL. More importantly, these studies have shown, not only the impact of major depression on HRQoL, but also the significant contribution of mixed depression and anxiety disorder and "subthreshold" disorders (patients who exhibit symptoms of depression and anxiety but the symptoms are not severe enough to warrant a diagnosis of anxiety and depression) on HRQoL. [58-60] Creed et al, found that both cases (with anxiety and/or depression) and subthreshold cases rated significantly lower HRQoL compared to controls, not only in the mental health domain, but

also on variables such as pain, physical limitation, and role functioning. Thus, highlighting the negative effect of psychological disorders on motivation for daily activities and perception of pain.[58] Moreover, co-morbidity with psychological disorders, had an additive effect on HRQoL, so, for example the combined effect of coronary artery disease and depressive symptoms resulted in double the reduction in social functioning, compared to either condition on its own. [59, 60]

2.5.5. Musculo-skeletal disorders on HRQoL

Muscular –skeletal conditions such as osteoarthritis or rheumatoid arthritis and chronic back pain has been found to greatly diminish HRQoL, in terms of both physical and mental health.[61,62] Furthermore, muscular-skeletal disorders have been found to have a much greater impact on HRQoL than potentially life-threatening conditions such as cardiac disorders. [62]

In summary, research of this kind has not been carried out in South Africa. This study is carried out at patient level and not at a community level. It is hoped that the findings of this study will pave the way for further research in this area.

Definition of persistent lower respiratory symptoms (PLRS)

Persistent lower respiratory symptoms included wheeze, tight chest, irritant induced asthma, asthma aggravation and COPD, present at year 1 and 6 year after exposure.

HRQoL scores

Health related quality of life – 8 scales Physical Functioning (PF), Role Physical (RF) Bodily Pain (BP), General Health (GH), Vitality (V), Social Functioning (SF), Role Emotional (RE) and Mental Health (MH).

3. Aim

To determine the degree of HRQoL impairment in residents with and without persistent lower respiratory symptoms and/or asthma, because of exposure to sulphur dioxide vapours due to the fire.

4. Objectives

- To describe the demographic characteristics of residents with or without persistent lower respiratory symptoms (PLRS) and/or asthma as a result of exposure to sulphur containing vapours associated with fire

- To determine the HRQoL scores (PF, RP, BP, GH, V, SF, RE and MH) among residents with or without PLRS and/or asthma at 6 years after the fire.

- To determine whether there is a difference in HRQoL scores between residents with or without PLRS and/or asthma.

- To determine the proportion of residents with or without PLRS and/or asthma, who experienced impairment in their HRQoL scores, as measured by a decline in HRQoL scores at 1 year and 6 years after the fire.

- To determine whether the impaired HRQoL scores, as measured by a decline in HRQoL scores, over 1 year and 6 years are related to age, gender, smoking status, **psychological state, past medical history, and PLRS and/or asthma.**

5. Purpose

The purpose of the study is to examine the impact of the fire on HRQoL amongst the residents of Maccassar, who developed PLRS and/or asthma due to the fire.

6. Methodology

6.1. Study Design

A cross-sectional descriptive study design.

6.2. Study population

The study population consists of 4000 residents of Maccassar who presented themselves to the Macassar disaster project clinic for medical evaluation due to acute health effects (mainly upper and lower respiratory symptoms) as a result of acute exposure to SO_2 vapours at the time of the fire. Within this group, there were a proportion of residents who experienced persistent lower respiratory symptoms and/or asthma 6 years after having been exposed to SO_2 vapours.

6.3. Sample size and procedure*:*

The sample in this study will be selected from a case – control study conducted by Baatjiies.[4] The sample will consist of 74 diseased (PLRS and/or asthma) and 172 non-diseased (no PLRS

and/or asthma). The inclusion criteria in this current study for diseased and non-diseased will be as follows:

Diseased group (PLRS and/or asthma)

Will consist of all the residents from Macassar who attended the clinic with persistent lower respiratory symptoms as a result of exposure to SO_2 vapours.

a) Residents of the Macassar area during the fire disaster (16 / 17 December 1995) and exposed to SO_2 as a result thereof.
b) Eighteen years or older at the time of exposure.
c) Presented themselves to the Macassar disaster project clinic for medical evaluation.
d) Must have had persistent (at year 1 and 6 years after the fire) respiratory symptoms and/ or asthma which in the opinion of the medical panel (MRP) was as a result of SO_2 vapours arising from the fire.
e) Absence of any chronic respiratory disease, including active pulmonary tuberculosis at least one year prior to and two after the disaster, and at five to 7 years after the fire.

Non-diseased group (No PLRS and/or asthma)

Will consist of a random sample of residents who did not develop lower respiratory symptoms and/or asthma despite exposure to SO_2 vapours. Similar to criteria a-c but free of persistent lower respiratory symptoms, asthma and other chronic respiratory illnesses such as TB at least one year prior to and two years after the disaster, and at five to 7 years after the fire.

The selection of diseased and non-diseased will be in accordance with the predetermined definition applied to a sampling frame constructed on the basis of attendance at the Macassar

disaster project clinic. A database of all attendees will be maintained. A proportion of the diseased residents will be selected and a random sample of non-diseased will be selected.

6.4 Data collection

Data collection will involve gathering information on the following parameters:

- Demographics
- Psychological Characteristics
- Medical history
- Presence or absence of lower respiratory symptoms due to the fire (health outcomes)
- Health related quality of life scores

Macassar –AECI fire disaster medical claimant's project, screening questionnaire – 2001: (Appendix 1)

The questionnaire was developed using background knowledge on symptoms suffered due to SO_2 exposure from the literature. In order to refine the questionnaire and to determine the time it would take to complete the questionnaire pre-testing will be done on the questionnaire. The questionnaire was compiled as a structured interviewer–administered questionnaire, which mainly consists of close – ended questions in order to limit interpretation bias.

To ensure reliability and validity the questionnaire will be translated into Afrikaans and then translated back into English. Furthermore, recording of observations and answers will be done in a systematic and accurate manner to ensure further reliability. A trained occupational health nurse with experience in data collection will conduct all interviews thus excluding interviewer variation, which may affect the reliability of the data collection process. A study such as this is prone to recall bias given that the subjects were asked about the impact on their quality of

life over the past six years. In order to minimise re-call bias the interviewees will be unaware of the hypothesis of the study and therefore are unlikely to answer questions according to the expected outcome.

Health – related quality of life assessment questionnaire (SF – 36): (Appendix 2)

The reason why SF -36 questionnaire will be used (given that it is a generic measure)for this study as opposed to an asthma specific questionnaire (disease specific) is because the residents who presented themselves to the Macassar disaster project clinic for a medical assessment and evaluation presented with various different diseases and medical conditions. As indicated previously, a generic questionnaire allows one to assess a range of diseases or conditions. Furthermore, a generic measure allows one to measure many health related dimensions and thus removes the need to select specific dimensions for any particular disease or medical condition. Therefore, the SF-36 is considered to be the most appropriate assessment tool, as it allows one to measure the impact of different diseases or medical conditions on HRQL, given the limited time and resources

The reliability, validity and responsiveness of the SF-36 has been widely reported in asthma.[17, 63-65] In addition the SF-36 has been used in many HRQL studies amongst asthma patients.[25, 28, 31, 41, 42, 66] Moreover, given that the SF-36 is the most widely used generic measure, the interpretation of the low and high scores are also well documented which allows for various different strategies to be implemented for the interpretation of results in a clinically significant way.[67, 68]

6.5 Ethical considerations

All information collected on clients during the course of the study will be kept under the strictest confidence, in order to preserve the client's privacy. Furthermore, the rights and welfare of the clients or their next-of-kin will be safeguarded by ensuring that a thorough explanation of the process of obtaining information and collection of data is provided. [69] In addition clients will be able to ask questions or discuss issues of importance during oral presentations to ensure the clients right to full disclosure. Written informed consent will be obtained only after it is clear that the client or the next-of-kin fully understood the purpose of the study. Unfortunately, the study cannot secure anonymity by replacing names of the clients with numbers as some of the clients may need to be referred for further medical evaluation, thus only confidentially can be guaranteed and not anonymity. All records will be kept in a locked cabinet for security reasons. Any agreement made between the researcher and the clients will be outlined and be honoured, particularly those relating to information on the outcome of the clients medical condition will be given in written form. All clients referred to specialist will be informed in writing concerning their diagnosis and treatment recommendations. All clients will be referred for legal assistance to assist with filing claims for compensation. (Appendices 3 & 4)

7. Data Management and Analysis

The following information on patient's characteristics will be obtained; age (years), age at the onset of asthma, sex/gender, cigarette-smoking habits (never, former, current), PLRS and/or asthma, reactive upper airways dysfunction (RUDS), treatment of asthma and finally, chronic disease: hypertension, diabetes, musculo-skeletal disorders, cardiac history and psychological disorders such as anxiety and depression. The above characteristics are likely to confound or

distort the relationship between asthma and HRQL, and therefore will be treated as potential confounders, and will be adjusted for in the analysis.

Dependent variable

Health related quality of life – 8 scales Physical Functioning (PF), Role Physical (RF) Bodily Pain (BP), General Health (GH), Vitality (V), Social Functioning (SF), Role Emotional (RE) and Mental Health (MH).

Independent Variables

1) Sex/gender (Female =1 vs. Male =2)

2) Age (Years)

3) Depression (depression = 1 vs. no depression = 2)

4) Anxiety (anxiety = 1 vs. no anxiety = 2)

5) Smoking (never = 1, ex-smoker = 2, current smoker = 3)

6) PLRS/ Asthma (PLRS/asthma =1 vs. no PLRS/asthma = 2)

7) RUDS (RUDS = 1 vs. no RUDS = 2)

8) Hypertension (hypertension = 1 vs. no hypertension = 2)

8) Diabetes (diabetes = 1 vs. diabetes = 2)

9) Cardiac disease (cardiac dx = 1 vs. no cardiac dx = 2)

10) Musculo-skeletal (MS =1 vs. no MS =2)

11) Treatment for asthma (no = 1 vs. high = 2)

7.1. Data Analysis:

The relationship between and HRQoL scores for the three periods

- Shapiro–Wilk test was conduct in order to assess if the scores for the eight health profiles PF, RP, BP, GH, V, SF, RE, and MH were normally distributed, for the three different time periods.

- Friedman's test (non-parametric test for more than 2 dependent samples) was conducted, to test the differences in the overall mean scores for the eight SF-36 scales.

The relationship between diseased/non-diseased and HRQoL scores for the three periods

- Conduct Shapiro-wilk test to test for normality for the diseased and non-diseased group.
- Conduct appropriate test in order to test for the differences in scores for the eight SF-36 scales and between the diseased and the non-diseased.

The independent variables and diseased/non-diseased, for the three time periods

- Stratified the total population according to diseased vs. non-diseased for the 3 different time points.
- Conduct Chi-square Test of Homogeneity between all the independent risk factors and diseased/non-diseased.

Table 1. Total population, stratified according to diseased vs non-diseased, prior to fire, at 1 year and 6 years after the fire

	Diseased (n =72)			Non-diseased (n = 174)		
	Prior	**1 year**	**6 years**	**Prior**	**1 year**	**6 years**
AGE **18 – 49 years** **50 – 80 years**						
SEX/GENDER Male female						
Smoking status **Never** **Previous** **Current**						
Level of exposure **Low** **High**						
Treatment for asthma **Yes**						
RUDS						
Anxiety						
Depression						
Diabetes						
Cardiac hx						
Hypertension						
Muscular-skeletal						

Linear Regression Analysis to determine the relationship between diseased/non-diseased and HRQoL

In order to determine the relationship between diseased/non-diseased and HRQoL, one would need to control for the following confounders: Age, sex/gender, depression, anxiety, smoking status, cardiac HX, hypertension, diabetes, muscular- skeletal disorders and treatment for asthma.

- Conduct simple linear regression analysis between all the independent variable and the PF, RP, BP, GH, V, SF, RE, and MH subscales scores, for the 3 time periods; this will describe the relationship between the independent variables and the 8 SF-36 subscales.

- Conduct multivariate linear regression analysis with PF, RP, BP, GH, V, SF, RE, and MH health profiles, and the independent variables, for the 3 time periods. This will determine the relationship between diseased/non-diseased and HRQoL, as the confounders will be adjusted for.

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SECTION B: STRUCTURED REVIEW

HEALTH-RELATED QUALITY OF LIFE IN ASTHMA: A REVIEW

Asthma is a chronic disease, which is known to impair psychological, physical and emotional well-being. [1] Symptoms of asthma such as shortness of breath, cough, chest tightness and wheeziness can restrict work and leisure activities, cause sleep disruptions and may result in high levels of anxiety and depression. [2, 3] This has lead to a growing interest, to assess the Health–Related Quality of Life (HRQoL) in asthmatics, and since the 1990's there has been a steady increase in published studies in this field. The aim of this review is to examine the results of studies, which have evaluated the impact of asthma on HRQoL. A MEDLINE search was undertaken using the keywords:

- Asthma and Quality of Life or Health Related Quality of Life;
- Asthma and SF-36 questionnaire; and
- Asthma and Rand SF-36 questionnaire.

Furthermore, review articles that where identified in the process where assessed for additional citations.

1. Health-Related Quality of Life

HRQoL is a multidimensional concept that incorporates psychological, social and physical dimensions of health. [1] HRQoL refers to the impact of different disease processes or treatment regimes on a person's emotional, social and physical domains of health, and how this limits the individuals' ability to function in the ordinary tasks. Each of these domains of health evaluate *objective functioning*, that can be measured by an observer and the patient, and *subjective wellbeing*, that can be measured by the patient only, such as level of distress, pain or anxiety experienced. [4-6] HRQoL research, therefore enables health care practitioners and

researchers to assess the impact of different diseases and treatment in a comprehensive manner, by integrating objective functioning and patients subjective wellbeing, thereby shifting the focus from a purely disease-centred approach to a more patient-centred approach.[7] This kind of approach is more in line with the World Health Organisation (WHO) definition of health in which health is: " a state of complete physical, mental and social well-being and not merely the absence of disease and infirmity". [8] The WHO's definition provides a holistic concept of health and implies that the focus of health care should not be simply to eradicate the cause of a particular disease or control of symptoms, but also to ensure, that patient's social and psychological well-being is adequately preserved. [9]

Measuring HRQoL in asthmatics is important, given that the traditional clinical outcome measures for asthma, such as the forced expiratory volume in one second (FEV_1), non-specific bronchial hyper-responsiveness, and medication use, are only moderately associated with HRQoL.[10] This suggests, that these measures do not adequately capture some important dimensions of individuals suffering from asthma, which can have a major influence on HRQoL. These include the patient's life experiences, socio-economic status, emotional status, health beliefs, perception of symptoms, and expectations of health.[11] Another reason for measuring HRQoL, is that any two individuals with the same disease process may have very different qualities of life, as their expectations of health, and their ability to cope with the limitations and disability, will impact on their perceptions of health.[11] Thus, patients who have a chronic disease such as asthma, measuring HRQoL, in addition to the traditional measures, provides a more meaningful way to determine the impact of health care, given that asthma can place a severe burden on emotional, physical and social aspects of an individual's life.

2. Measuring HRQoL

There are two types of HRQoL measures: the *generic measure* and the *disease specific measure* (Table 1). A generic measure can be applied to general or specific populations, in order to assess the impact of a range of different diseases or treatment regimes. One of the main features of a generic measure is that it allows for the assessment of many dimensions of health in a comprehensive manner and removes the need to select specific dimensions for any particular disease. Furthermore, generic measures can be useful in comparing the findings of different diseases or conditions. However, one of the main drawbacks of generic instruments is that they are less responsive to clinical changes. [12, 13] Unlike the generic measures, the disease specific measures have superior responsiveness and discriminating ability, because the disease specific measures are specifically tailored to the problems of the patient, by including only the relevant dimensions of a particular disease. The main drawback of disease specific questionnaires is the lack of comparability of the results from different diseases or conditions.[13] Irrespective of which measurement instrument is selected, an important consideration when choosing an instrument to assess HRQoL, is that the instrument should be valid, reliable and responsive. Moreover, investigators are not restricted to using generic or disease specific questionnaires, since both types of questionnaires can be used in combination as they can yield complementary information. [14]

Table 1. Disease-specific and generic questionnaires used in adult patients with asthma.

Questionnaire type	Diseases
Disease specific Questionnaires	
Asthma Quality of Life Questionnaire (AQLQ)[15]	Asthma
Mini-Asthma Quality of Life Questionnaire (Mini-AQLQ)[16]	Asthma
St. George's Respiratory Questionnaire (SGRQ)[17]	Asthma,COPD
Modified Marks Asthma Quality of Life Questionnaire (AQLQ-M)[18]	Asthma
Quality-of –Life for Respiratory Illness Questionnaire (QOL-RIQ) [19]	Asthma,COPD
Living with asthma Questionnaire(LWAQ) [20]	Asthma
Airways Questionnaire (AQ20)[21]	Asthma
Integrated Therapeutics Group Asthma Short Form (ITG-ASF) [22]	Asthma
Life Activities Questionnaire for Adult Asthma [23]	Asthma
Generic Questionnaires	
MOS Short-Form 36 questionnaire (SF-36)[24]	All diseases
MOS Short-Form 12 questionnaire (SF-12)[25]	All diseases
Sickness Impact Profile Questionnaire (SIP)[26]	All diseases
Nottingham Health Profile Questionnaire (NHP)[27]	All diseases
Euro Quality of Life Questionnaire (EuroQOL)[28]	All diseases
Quality of Well-being Scale (QWB)[29]	All diseases

3. Determinants of HRQoL in asthmatics

3.1. Age

There have been inconsistent reports on age and HRQoL in asthmatics. Some studies have shown age to be a contributory factor on HRQoL in asthmatics, whereas other studies have reported findings to the contrary. Juniper et al found that younger asthmatic patients had significantly diminished HRQoL compared to the older asthmatic group. [2] This was attributed to greater adaptation to the limitations caused by asthma amongst the elderly, resulting in elderly asthmatics being less distressed by their asthma then younger adults. [2] In contrast, Bousquet et al found that, older asthmatic patients reported poorer HRQoL in the SF-36 domains physical functioning, bodily pain and general health compared to younger

asthmatics. [30] Findings from other studies are consistent with Bousquet et al. [31, 32] It is argued that among the elderly, co-morbidity may well account for the association between age and poorer HRQoL. [33] Erickson et al, on the other hand, found that age was not significantly associated with HRQoL in asthmatics, using both AQlQ and the SF-36 questionnaire.[34] Apter et al findings were similar to Erickson et al. [11]

3.2. Sex/gender

Several epidemiological studies have demonstrated a relationship between sex/gender and HRQoL, in which female asthmatic patients reported a poorer HRQoL and symptoms compared to male asthmatics. [30, 35-40] In a follow-up study by Sundberg et al, female asthmatics patients, scored significantly lower with LWAQ and in the SF-36 domains of Physical Functioning and General Health compared to male asthmatics. [35] In a population based study, Osbourne et al's found that asthmatic women between the ages of 35-55 years reported significantly poorer HRQoL in the SF-36 domains Physical Functioning, Social Functioning and Bodily Pain compared to asthmatic men. [36] Wijnhoven et al study found that women with asthma rated a poorer HRQoL for both QOL-RIQ and NHP questionnaires.[37]

Despite, the abundance of literature assessing the relationship between sex/gender and HRQoL in asthmatics, very few studies explore the reasons for these observed sex/gender differences. Wijnhoven et al argued, that the sex/gender differences cannot be accounted for by differences in '*objective disease severity'*, since women had generally higher pulmonary function levels than men, but the differences are likely to be explained by '*subjective disease parameters'*. Women reported more severe dyspnoea, and a higher use of medication compared to men in their study. Given that dyspnoea is one of the main symptoms of anxiety

disorders, and asthmatic women experience far greater psychological disorders, such as mood and anxiety disorders, compared to men, suggested that women may have more severe asthma in terms of '*subjective disease parameters'*. [37] Belloch et al also found in their study, that dyspnoea was the best predictor of HRQoL in asthmatic women, and this they argue may be related to, the higher anxiety and depression scores in women compared to men. Belloch et al further argue that the contribution of emotional disorders on HRQoL in asthmatic women is further compounded by age. Hence, as women aged, they experience more emotional disorders, thereby further diminishing their HRQoL compared to men. [38]

3.3. Smoking status

There appears to be a significant negative association between smoking status and HRQoL in individuals with asthma. In a longitudinal study by Sippel and colleagues, current smokers and ex-smokers reported significant impairment in their HRQoL, compared to non-smokers. Current smokers reported impairment in HRQoL for two of the five domains of the AQLQ, whereas ex-smokers reported impairment in HRQoL for all the five AQLQ domains, compared to non-smokers. With regard to the SF-36 health survey instrument, both current and ex-smokers rated poor HRQoL in the following SF-36 domains: Physical Functioning, Mental Health, Vitality and General Health, compared to non-smokers.[41] Ford et al, also found strongly negative associations between smoking and HRQoL in asthma.[33.]

3.4. Socioeconomic status

Given the extensive literature on socioeconomic status (SES) and health, there appears to be a lack of consensus on what actually constitutes SES in health care research.[42] Studies that have examined the relationship between SES and HRQoL in asthmatics have used different

definitions of SES. However, despite this limitation, studies have consistently shown SES to impair HRQoL in asthmatics.[11, 43]

SES can be measured at an *individual level* and/ or at an *area level*. At an individual level, SES can include variables such as: level of education, occupation, household income and type of health insurance, all of which reflect social and economic status. At an area level, SES includes variables such as: income measures, education patterns, employment rates, average home values and the level of social grants provided. The inclusion of SES, both at an individual level and at an area level, is particularly relevant in asthma research. At individual level exposures that are directly related to SES such as high levels of respiratory irritants or sensitizers in lower-paying occupations; exposures from the use of blomass fuels or cooking stoves; and environmental tobacco smoke exposures, are likely to adversely affect asthmatics. Similarly, at an area level, exposures relating to SES such as poor air quality due to traffic density, high levels of pollution due to close proximity to industrial area, and social – community stressors are also likely to negatively affect asthmatics. [43]

Blanc et al, assessed the relationship between SES, at an individual level (level of education, Annual income and employment status) and at an area level (e.g. income below poverty level %, Unemployment %, single parent household %) on HRQoL using SF-12 PCS and AQLQ-M in asthmatics. The study found, that lower area level SES was significantly associated with poorer General Health, as measured by SF-12 PCS scale and resulted in significant impairment in HRQoL as measured by AQLQ-M.[43] Apter et al, also found a strong association between individual level SES (education level, household income, occupational status and type of health insurance) and HRQoL. The study demonstrated that individuals with lower education, who were unemployed and had lower household income, had poorer

asthma control, which contributed significantly to impaired HRQoL in both the AQLQ and Physical Component Summary (PCS) of the SF-36.[11]

3.5. Asthma Severity

It is well known that individuals with severe asthma are likely to encounter greater physical limitations and experience different levels of impairment, compared to individuals with mild asthma.[9] Epidemiological studies have consistently shown a strong relationship between asthma severity and impaired HRQoL. [9, 30, 34, 44, 45] However, the strength of the association between asthma severity and impaired HRQoL is largely dependent on the criterion used to define asthma severity. Studies that have used purely objective measures such as forced expiratory volume in one second (FEV_1), have found poor association between asthma severity and HRQoL, compared to studies that have used both subjective (diary cards of symptoms, symptom intensity and the use of β_2-agonist) and objective measures of asthma severity.[7]

Ehrs et al found no relationship between asthma and HRQoL using the AQLQ. The study used objective measures of asthma such as lung function, reversibility to a bronchodilator, bronchial hyper responsiveness, and exhaled nitric oxide. [46] The findings of the study confirms the general consensus, that asthmatic patients are more likely to be distressed and are more concerned about the symptoms of their asthma, and the limitations caused by their asthma (subjective dimensions) as opposed to objective dimension of their asthma. [7] Moy et al's study, also demonstrated this finding. The study assessed the relationship between clinical predictors of HRQoL and asthma severity (defined using, FEV_1, diary card of symptoms and symptom intensity as recorded by patients and the number of rescue puffs of β-agonist used) using AQLQ. The study found that for all the AQLQ domains, patients with

mild asthma and moderate to severe asthma reported poor HRQoL. However, patients with moderate-severe asthma reported significantly poorer HRQoL compared to patients with mild asthma. Furthermore, rescue puffs of β-agonist and symptom intensity of shortness of breath, wheeze, and cough were found to be significant predictors of HRQoL in patients with mild asthma whereas, in patients with moderate-severe asthma, only symptom intensity of shortness of breath and cough were significant predictors of HRQoL. [44]

The study by Muraki et al, found that patients with moderate to severe asthma rated poorer HRQoL scores for the AHQ subscales of High asthma symptoms, Factors which Worsened Symptoms, Emotion, and Daily Activity and the SF-36 domains of, Physical Functioning. [45] Similarly, Reid et al in their study of moderate-severe asthma patients, using the SF-36 questionnaire, found the SF-36 subscales Physical Functioning, General Health and Vitality were profoundly affected in patients with severe asthma. [9] Other studies that have used the SF-36 questionnaire have reported similar findings, in which patients with moderate to severe asthma experienced significant impairment in their physical health and less so in their psychological health. [30, 34]

Although, one would expect greater psychological impairment in moderate to severe asthmatics, given the high level of impairment in physical health, this is not borne out in the literature. Diminished physical functioning can lead to restrictions in work and leisure activities and can create higher levels of frustration and anxiety. However, it is argued that asthmatics patients adapt to the physical limitations caused by their disease. Moreover they reduce their expectations for their health and activities.[9] Furthermore, ten Brinke et al argue, that it is more likely that morbidity and costs of asthma may be related to psychological dysfunctioning in patients with severe asthma, rather than asthma severity per se.[47]

3.6. Asthma treatment

Studies, which have looked at the impact of treatment guidelines [National Institute of Health International asthma guideline (NIH), and Global Initiative for Asthma (GINA) on HRQoL, have found significant improvements in the HRQoL amongst asthmatics. [48-51]

Bateman et al found that well–controlled asthmatics as defined by the GINA guidelines experienced significant improvements in their HRQoL. The study found that irrespective of asthma severity, well-controlled asthmatics scored higher for all AQLQ domains over an 8-week period. Some patients achieving scores of 7 (1 = severe impairment and 7 = no impairment) on the AQLQ. More importantly, the study found that patients receiving Salmeterol/ fluticane propionate combination therapy (SFC) experienced significant improvement in their HRQoL irrespective, of whether they were well controlled or not. [48]

Pont et al compared the HRQoL of asthma patients receiving treatment according to NIH and those patients receiving non-guideline treatment and, found patients that received guideline treatment, had superior AQLQ HRQoL compared to patients with non-guideline treatment. [40] Other studies have also reported similar findings. [50, 51]

3.7. Asthma and co-morbidity

Studies have demonstrated the adverse impact of co-morbidity on HRQoL amongst those suffering from chronic diseases, particularly amongst the elderly. Evaluation for co-morbidity in patients with asthma is important for several reasons. Failure to assess co-morbidity in asthma can distort the true relationship between asthma and HRQoL. Equally important is to identify the relationship between co-morbidity and HRQoL in patients with asthma. [52]

3.7.1. Allergic rhinitis

Allergic rhinitis and asthma frequently coexist. Indeed, in recent years the united airways concept has gained prominence, highlighting the similarities in pathophysiology between allergic rhinitis and asthma.[52] Numerous studies have assessed the relationship between asthma and allergic rhinitis and HRQoL. [52-54] In a study by Kalpaklioglu and colleagues, which examined the impact of allergic rhinitis on asthma and HRQoL, found that patients with allergic rhinitis experienced significantly greater impairment for the SF-36 scales Role Physical and Mental Health, whereas, patients with asthma reported significant impairment in Physical Functioning. Furthermore, the study found that allergic rhinitis did not further impair HRQoL in asthmatics.[52] In a population based study by Leynaert and colleagues, which examined the impact of asthma on allergic rhinitis, found that patients with allergic rhinitis experienced greater impairment in their mental health. Patients with allergic rhinitis scored significantly lower for the SF-36 subscales General Health and Vitality and for the Mental Component Summary (MCS). Moreover, the study found that in patients with both allergic rhinitis and asthma, there was further impairment in physical health. Thus, patients with allergic rhinitis and asthma experienced HRQoL impairment, not only in the SF-36 domain General Health, Vitality, but also in the Physical Functioning domain. [53]

3.7.2. Non respiratory co-morbidity.

Wijnhoven et al is one of few studies, which examines, the impact of co-morbidity on HRQoL in asthmatic patients, using both the QoL-RIQ and NHP questionnaires. The study reported that co-morbidity is an important determinant of both QoL-RIQ and NHP HRQoL among asthmatics, and that, the presence of more than one co-morbidity, significantly decreases the HRQoL in asthmatics. In addition, the study demonstrated that asthmatics with cardiac history and hypertension had lower QoL-RIQ HRQoL scores compared to NHP

HRQoL scores. Furthermore, asthmatics with musculoskeletal disorders had the poorest NHP HRQoL scores. The impact of diabetes and other chronic diseases were however, not significant; but, this may be due to the small sample size of this group. [55]

One of the major limitations of the Wijnhoven study was that it did not examine the contribution of psychological disorders on HRQoL in asthmatics. Asthmatic patients are known to report higher rates of anxiety and depression compared to the general population.[56] Moreover; studies have shown the adverse effect of depression and anxiety on HRQoL in asthmatics. [57, 58] Asthmatics with more depressive symptoms rate significantly lower HRQoL scores compared to asthmatics with less depressive symptoms. [57]

4. Summary

This review has highlighted some of the important literature on HRQoL in allergic asthma. sex/gender, age, smoking status, socioeconomic status, asthma severity, asthma treatment and co-morbidity with asthma are found to be predictors of HRQoL among asthmatics. Future areas of research need to focus on irritant induced asthma.

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SECTION C: JOURNAL MANUSCRIPT

HEALTH-RELATED QUALITY OF LIFE AMONG MACASSAR RESIDENTS WITH PERSISTENT LOWER RESPIRATORY SYMPTOMS AND/OR ASTHMA FOLLOWING A SULPHUR STOCKPILE FIRE DISASTER.

M Rajani

Abstract

Aim: To determine the health-related quality of life (HRQoL) in Macassar residents with persistent lower respiratory symptoms and/or asthma (PLRS and/or asthma), six years after exposure to sulphur dioxide vapours emanating from a sulphur stockpile fire disaster.

Methods: A cross-sectional analysis of responses from affected residents was conducted six years after the incident. Information was obtained from a dataset of 4000 respondents to an interviewer-administered questionnaire that included medical history, respiratory symptoms and HRQOL using the Medical Outcomes Study Form 36 (SF-36). The respondents surveyed six years after the fire, provided information for three different time points, prior to, one year and six years after the fire.

Results: A total of 246 records of residents, 74 with PLRS/asthma and 172 without PLRS/asthma were analysed. The mean age of the symptomatic group was 49 (SD:12) years and 47 (SD:13) years in those without PLRS and/or asthma. Approximately 60% of the residents were current and ex-smokers in both groups. A greater proportion were women (61.3%) and 68% of women reported PLRS/asthma. The mean SF-36 scores were significantly lower for the symptomatic group in the Physical Functioning (24 vs. 39), Role Physical (33 vs. 48) and General Health domain (24 vs. 37). Residents with PLRS/asthma, were more likely to experience a significant decline in their Role Physical (OR=1,97; CI

1,09-3,55) and General Health (OR=7,07; CI 2,88-17,35) at year 1 and General Health (OR=3,50; CI 1,39-8,79) at year 6, compared to those without PLRS and/or asthma. Residents with co-morbid RUDS (reactive upper airways dysfunction syndrome) demonstrated even stronger associations for General Health (OR=7,04; CI 1,61-30,7) at year 1 and at year 6 (OR=8.58; CI 1,10-65,02).

Conclusion: This study highlights the long-term adverse impact on HRQOL among residents with lower and upper airways disease following a sulphur stockpile fire disaster.

Keywords; Persistent symptoms, asthma, Health related quality of life, Upper airways, lower airways.

Abbreviations

PLRS and/or asthma - Persistent lower respiratory symptoms and / or asthma
RADS - Reactive Airways Dysfunction Syndrome
RUDS - Reactive Upper Airway Dysfunction Syndrome
COPD - Chronic Obstructive Pulmonary Disease
HRQoL - Health-related quality of life
SF-36 - SF-36 Health Survey
PF – Physical functioning
RP – Role physical
BP – Bodily Pain
GH – General Health
V – Vitality
SF – Social Functioning
RE – Role Emotional
MH – Mental Health

Introduction

Asthma is a chronic disease, which is known to impair psychological, physical and emotional well- being [1] Symptoms of asthma can restrict work and leisure activities, cause sleep disruptions and may lead to high levels of frustration, anxiety and depression. [2-3] This has lead to a growing interest, in the relationship between Health–Related Quality of Life (HRQoL) and asthma. HRQoL refers to the impact of different disease processes or treatment on an individual's emotional, social and physical domains of health, and how this limits the individual's ability to function in the ordinary tasks. [4] HRQoL research therefore enables health care practitioners and researchers to assess the impact of different diseases and treatment in a comprehensive manner, by integrating objective functioning and patients' subjective wellbeing, thereby shifting the focus from a purely disease-centred approach to a more patient-centred approach. [5]

Measuring HRQoL in asthma is important, given that the traditional outcome measures for asthma, such as the forced expiratory volume in one second (FEV_1), bronchial hyper-responsiveness, and medication use are only moderately associated with HRQoL. [6] This suggests that these measures do not adequately capture some important dimensions of asthmatics, which can have a major influence on their HRQoL. These include individual's life experiences, socio-economic status, emotional status, health beliefs, perception of symptoms, and expectations of health. [7] In individuals with chronic disease such as asthma, measuring these factors that influence HRQoL in addition to the traditional measures, provides a more meaningful way to determine the impact of health care, given the emotional, physical and social burden experienced by individuals with asthma.

Numerous studies have addressed the impact of asthma on HRQol, using well-validated instruments. [8-10] Most studies have consistently found asthma to overwhelmingly impair the physical health of those suffering from asthma. [8-11] The relationship between age and HRQoL in asthma remains inconclusive. Some studies have shown that older asthmatics have poorer HRQoL. [9, 13] In contrast, others suggest, that older asthmatics are less distressed by their asthma, due to adaptation to the limitations caused by their asthma, than younger asthmatics. [2,14] Furthermore, there appears to be a sex/gender differential, in which female asthmatics experience significantly poorer HRQoL compared to their male counterparts. [9,15,16] A strong association has been found between smoking status and HRQoL in individuals with asthma. Current smokers and ex-smokers were found to experience significantly poorer HRQoL, compared to non-smokers. [17,18]. The adverse impact of socioeconomic status (SES) on HRQol in asthma, has also been documented, in which, individuals from lower SES (both at an 'individual *level*' and at '*area level'*) reported significantly impaired HQRoL [7, 19] Strongly positive associations have been observed between severity of asthma and HRQoL. Individuals with severe asthma are more likely to encounter greater physical limitation and impediments, compared to individuals with mild or moderate asthma. [8,9] Significant improvements in HRQoL have been noted in patients on standard treatment guideline regimes[1997 National Institute of Health International asthma guideline (NIH) and Global Initiative for Asthma (GINA)], compared to non-guideline treatment regimes [20,21] In terms of co-morbidity, allergic rhinitis was found not to impair HRQoL in asthmatics. [22] However, asthma was found to significantly impair HRQoL in patients with allergic rhinitis [23] Furthermore, other chronic diseases such as hypertension, cardiac diseases, diabetes, arthritis and psychological disorders, have all been found to significantly impair HRQoL in asthmatics. [24]

On the 16-17 December 1995, 15 000 tons of sulphur ignited, resulting in exposure of high levels of sulphur dioxide (SO_2) vapours amongst the Macassar residents and the surrounding residential and farming areas.[25] Approximately, 30,000-40,000 people were living in Macassar at the time of the disaster. This kind of chemical disaster, namely the burning of a sulphur stockpile, was the first of its kind. Elsewhere in the world, major chemical disasters have also been reported, the Bhopal disaster in India and the Seveso disaster in Italy. The Bhopal disaster, was associated with exposure to methyl isocyanate gas resulting in a wide range of health effects that included eye problems, respiratory difficulties, immune and neurological disorders, cardiac failure, female reproductive problems and birth defects among children born to affected women. [26] The Seveso disaster resulted in exposure to high levels of 2,3,7,8-tetrachlorodibenzo-p-dioxin, with reported health effects that included chloracne, peripheral neuropathy and liver enzyme dysfunction. [27]

Following the sulphur fire, the Macassar disaster project clinic was established with legal assistance from the Legal Aid Board in South Africa to assist residents that were affected by this disaster. Approximately, 4000 residents attended the clinic reporting various organ-specific system complaints perceived to be associated with exposure to the sulphur fire. These complaints were diverse affecting the ocular-nasal, respiratory, gastro-intestinal, dermatological and neuro-psychiatric systems. A large proportion of the residents had respiratory complaints, having aggravation of their asthma or new onset irritant induced asthma (reactive airways dysfunction syndrome – RADS). It is this subgroup of individuals that are the subject of the current study. The aim of the study was to determine the HRQoL in Macassar residents with and without persistent lower respiratory symptoms and/or asthma

(PLRS and/or asthma), six years after exposure to vapours emanating from a sulphur stockpile fire disaster.

Methods

Recruitment and sample

A cross-sectional analysis of data collected over a period of 24 months (May 2001 to May 2003) was conducted. The study population dataset originally consisted of 4000 residents of Macassar who presented six years later to the Macassar disaster project clinic for a medical evaluation following health complaints as a result of acute exposure to SO_2 vapours at the time of fire. Within this group, there were residents with pre-existing asthma who experienced further aggravation of their asthma and a proportion of residents who developed new onset of persistent lower respiratory symptoms and/or asthma (PLRS and/or asthma) (Figure 1).

Power calculations were conducted using STATA version 8 statistical software. Based on these calculations a sample of 74 adult residents with PLRS and/or asthma and 172 adult residents without PLRS and/or asthma were selected. This was based on having > 80% power and 95% confidence and a background exposure prevalence of 25% and 50% among residents with PLRS and/or asthma and residents without PLRS and/or asthma respectively. All residents with PLRS and/or asthma were selected and a random sample of residents without PLRS and/or asthma were selected. All the residents participating in the study provided written consent and the research protocol was approved by the Research Ethics Committee of the University of Cape Town.

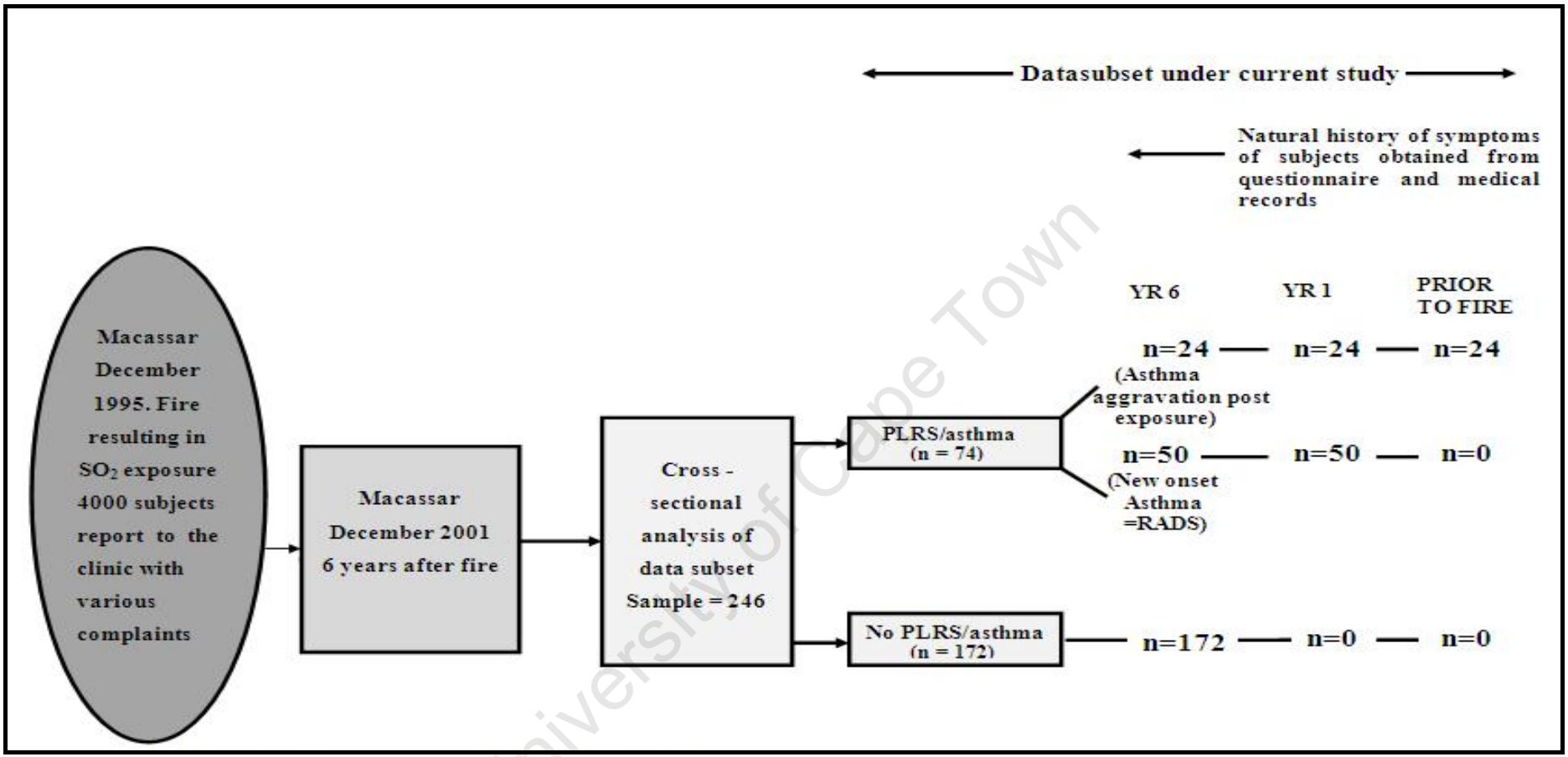

Figure 1. Schematic outline of dataset under current study

Questionnaires

Information from residents was obtained through a structured interviewer-administered questionnaire. The first part of the questionnaire was used to obtain data pertaining to demographic characteristics, exposure history, co-morbidity and health symptoms experienced prior to, at year 1 and 6 years after the disaster. Additional information on socio-economic status and health care utilisation was not collected from the participants, as these variables were not considered to be differentially distributed in a major way among the residents of this working class area. The second part of the questionnaire collected data on HRQoL and consisted of the generic health status questionnaire, the SF-36 health survey. [28] The SF -36 questionnaire incorporates eight scales, viz. (1) physical Functioning (PF), (2) Role – Physical (RP), (3) Bodily Pain (BP), (4) General Health (GH), (5) Role – Emotional (RE), (6) Mental Health (MH), (7) Vitality (VT), (8) Social Functioning (SF).

Definition of PLRS and/or asthma

Persistent lower respiratory symptoms included wheeze, tight chest, or a doctor diagnosis of obstructive lung disease (irritant induced asthma, asthma aggravation and COPD), present at year 1 and 6 year after the incident. The presence of current active pulmonary TB within one year of these time points was regarded as an exclusionary criterion.

Statistical analysis

Statistical analysis was performed using STATA version 10 (StataCorp, College Station, TX, USA). The Rand 36-item scoring procedure was used. A two-step scoring process was implemented, the first step involved recoding some items, and step 2 involved averaging the items in the same scale. The scores from all the eight scales range from 0 to 100 with a high score being consistent with a positive health status. [29]

The eight scales of SF-36 HRQoL were defined as the dependant variables and the main predictor of interest was PLRS and/or asthma. The other covariates considered were age, sex/gender, smoking, current treatment of asthma, previous history of pulmonary TB, hypertension, cardiac disease, diabetes, arthritis, depression and anxiety. Normality of data was tested using Shapiro Wilk test. The non-parametric Mann-Whitney test was conducted to test for the differences in the scores of the eight SF-36 scales between residents with and without PLRS and /or asthma, 6 years after the fire. The mean differences for seven of the SF-36 scales (missing data for scale Physical Functioning prior to the fire and year 1) were calculated by subtracting the SF-36 HRQoL scale scores for year 1 from the baseline scores prior to the fire and similarly, for year 6, stratified according to the presence and absence of PLRS and/or asthma.

Univariate and stepwise multiple linear regression analysis (with the eight SF-36 scales as the dependent variable) was performed, to determine the relationship between the eight SF-36 scales scores and the presence of the predictor of interest and the other covariates: age, sex/gender, smoking status, treatment for asthma, Pulmonary TB, Reactive Upper Airways Dysfunction Syndrome (RUDS), hypertension, cardiac disease, diabetes, arthritis, depression and anxiety. Multivariate logistic regression models adjusted for age, sex/gender, smoking, pulmonary TB, cardiac history and depression (anxiety was not included in the model as it was found to be highly correlated with depression) were used to determine the contribution of PLRS and/or asthma towards decline in HRQoL with as well as without co-existing RUDS morbidity. A decline of more than 5 points in the SF-36 (0-100 scale) was considered to be of clinical significance. [30]

Results

The demographics characteristic (age, sex/gender and smoking status) were very similar between residents with PLRS and/or asthma and those without PLRS and/or asthma; except for the previous history of pulmonary TB, which was more prevalent, among those with PLRS and/or asthma. The mean age of the 246 respondents was between 40-50 years with almost 60% being current or ex-smokers and a greater proportion were females (61.3%). A significant amount of residents (72.7%) reported suffering from at least one other chronic disease. The prevalence of depression and anxiety was similar, while cardiac disease and diabetes more common in the residents with PLRS and/or asthma and musculo–skeletal diseases more prevalent in residents without PLRS and/or asthma (Table 1).

Table 1: Demographic and health related characteristics of Macassar residents stratified according to the presence of persistent lower respiratory symptoms and/or asthma 6 years after the fire (n=246)

	PLRS and/or asthma after the fire (n=74) N (%)	No PLRS and/or asthma after the fire (n=172) N (%)
Demographic characteristics		
Age (years) Mean ± SD	49 ± 11.9	47 ± 13.0
Female	51(68.9)	111 (64.5)
Smoking status		
Never	30 (40.5)	71 (41.2)
Previous	29 (39.1)	52 (30.2)
Current	15 (20.2)	49 (28.4)
Previous Pulmonary Tuberculosis	13 (17.5)	16 (9.3)
Current treatment for asthma	45 (60.8)	0 (0)
Other chronic diseases		
Hypertension	17 (22.9)	44 (25.5)
Cardiac disease	8 (10.8)	11 (6.3)
Diabetes	10 (13.5)	12 (6.9)
Arthritis	3 (4.0)	22 (12.7)
Depression	8 (10.8)	15 (8.7)
Anxiety	10 (13.5)	19 (11.0)

A significant proportion of women (68%) reported PLRS and/or asthma. Of the 74 residents with PLRS and/or asthma, 63% reported a doctor diagnosis of reactive airways dysfunction syndrome (RADS), 32.4% asthma aggravation and 42% reactive upper-airways dysfunction syndrome (RUDS) (Figure 2).

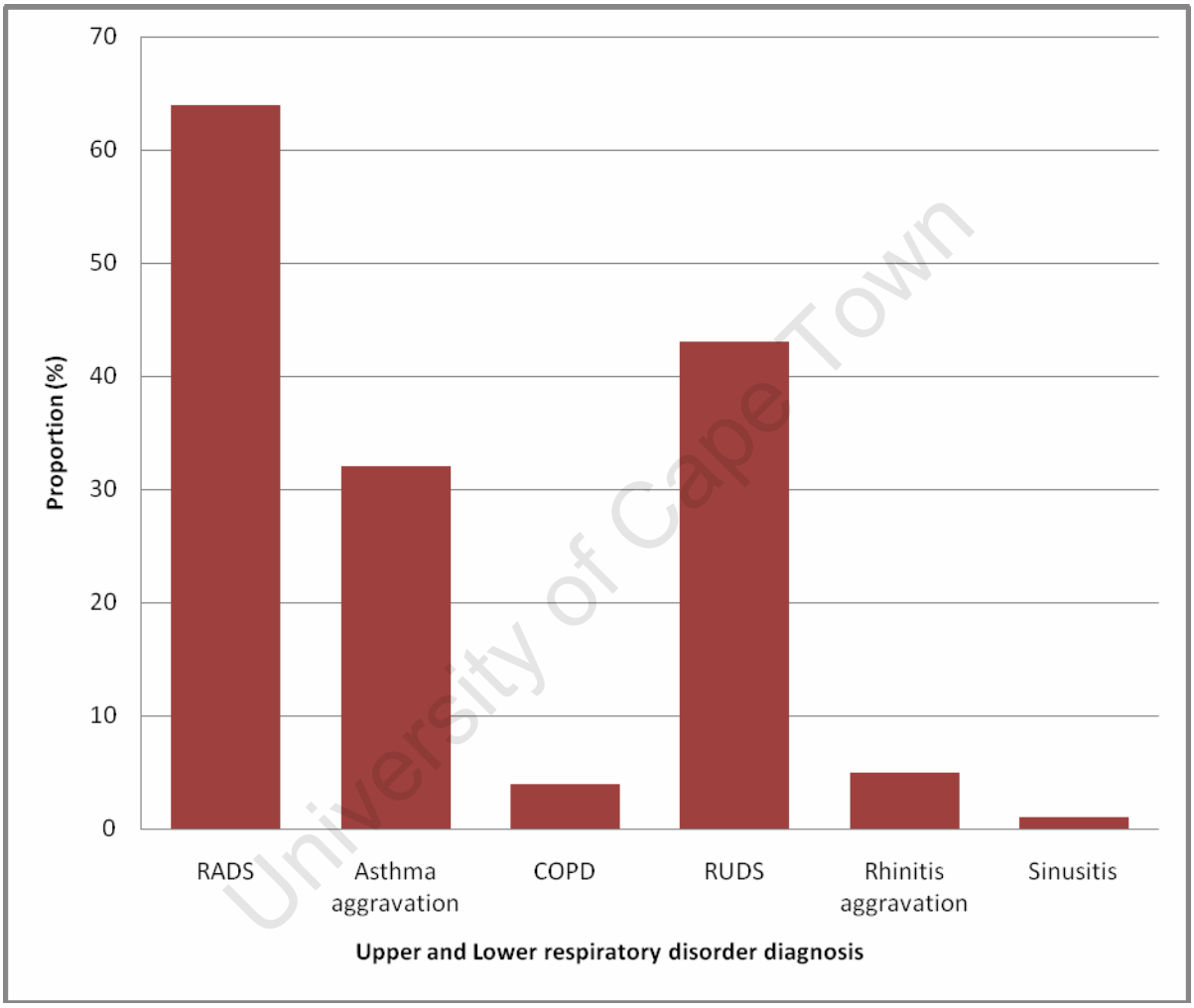

Figure 2. Prevalence (%) of upper and lower respiratory disorder diagnosis in Macassar residents reporting PLRS and / or asthma (n =74) 6 years after the fire

RADS – Reactive Airways Dysfunction Syndrome, COPD – Chronic Obstructive Pulmonary Disease
RUDS – Reactive Upper Airways Dysfunction Syndrome

Approximately, 43% of residents with PLRS and/or asthma also had RUDS and residents with RUDS all had co-existing RADS. A higher proportion of residents with asthma had moderate to severe asthma [28% of the residents with PLRS and/or asthma had severe asthma (FEV_1 <50% predicted), 18% had moderate asthma (FEV_1: 51-60% predicted)] compared to mild asthmatics [37% had mild asthma (FEV_1: 61-80% predicted)]. Only 60% of the residents were on current asthma treatment at 6 years.

The overall mean scores for each of the SF-36 scale at year 6 were Physical Functioning 29 ± 27.3, Role Physical 44 ± 48.3, Bodily Pain 64 ± 30.9, General Health 33 ± 24.8, Vitality 51 ± 20.6, Social Functioning 60 ± 28.6, Role Emotional 49 ± 49.3 and Mental Health 51 ± 20.6. At year 6 residents with PLRS and/or asthma scored lower for all domains of SF-36 with the exception of Bodily Pain scale, compared to residents without PLRS and/or asthma, 6 years after the fire. A similar pattern was observed for the scores at year 1 (Appendix 5). The scores representing the physical health component scales viz. Physical Functioning, Role-Physical and General Health were significantly lower in residents with PLRS and/or asthma, $p < 0.05$ (Table 2).

Furthermore, the mean difference in scores were significantly lower for Role Physical (-36 vs. -24; p=0.036) and General Health (-50 vs. -30; p<0.001) at year 1, and for General Health (-50 vs. -38; p=0.004) at year 6 in residents with PLRS and/ or asthma (Appendix 5).

Table 2. Health-related quality of life SF-36 scale scores of Macassar residents stratified according to the presence of persistent lower respiratory symptoms and/or asthma 6 years after the fire (n=246)

	Physical Functioning		**Role Physical**		**Bodily Pain**		**General Health**	
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)
PLRS/Asthma	24±25.1	15 (0-35)	33 ± 45.9	0 (0-100)	67 ± 30.8	78 (33-100)	24 ± 17.8	19 (13-32)
No PLRS/Asthma	39±28.5	35 (18-35)	48 ± 48.7	0 (0-100)	67± 31.0	78 (33-100)	37 ± 25.9	32 (13-56)
p-value	**<0.001**		**0.024**		0.797		**< 0.001**	
	Vitality		**Social Functioning**		**Role Emotional**		**Mental health**	
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)
PLRS/Asthma	50 ± 20.1	50 (35-65)	57 ± 28.8	55 (33-80)	46 ± 49.2	0 (0-100)	62 ± 26.9	60 (36-88)
No PLRS/Asthma	52 ± 20.6	50 (40-65)	62 ± 28.2	68 (43-80)	51± 49.1	63 (0-100)	63 ± 24.9	60 (44-84)
p-value	0.685		0.239		0.535		0.883	

Mann-Whitney test

Multivariate linear regression models demonstrated that all predictors of HRQoL investigated were inversely correlated with the SF-36 scale scores (Table 3). Furthermore, in addition to PLRS and/or asthma, age, sex/gender, depression, anxiety and cardiac disease was the most important determinants of physical health-related HRQoL scores, while age, sex/gender, smoking status, depression and anxiety were important predictors of mental health-related HRQoL scores. Aside from depression and anxiety, residents with PLRS and/or asthma were more likely ($p<0.05$) to have lower scores for the following three SF-36 scales Physical Functioning (-13.13), Role-Physical (-13.9) and General Health (-12.84) at year 6. The Physical Functioning model explained the greatest variability in the HRQoL scores (33%). Further, residents with RUDS were more likely to have lower scores for the scale General Health model [$\beta = -9.57$ ($p=0.04$)].

A significantly larger proportion of residents with PLRS and/or asthma, reported clinically significant decline (5 points) in scores for the SF-36 scales than the asymptomatic group at year 1 viz. Role- Physical (40.5% vs.27.3 % $p=0.04$)) and General Health (92% vs. 62% $p<0.001$). Similarly, a significantly higher proportion of the residents with PLRS and/or asthma experienced a significant decline in their General Health, compared to residents without PLRS and/or asthma (91.8% vs. 76.7% $p=0.005$), at year 6 (data not shown).

Table 3. Significant determinants of health-related quality of life according to SF-36 scale scores of Macassar residents 6 years after fire (n=246) in multivariate linear regression models

	B Coefficient (p-value)							
	PF	RP	BP	GH	V	SF	RE	MH
Constant	89.18 (<0.001)	85.35 (<0.001)	91.08 (<0.001)	44.59 (0.033)	64.40 (<0.001)	62.63 (<0.001)	98.89(<0.001)	77.42 (<0.001)
Age (years)	-0.78 (<0.001)	-0.73 (0.002)	-0.45 (0.002)		-0.23 (0.020)		-0.75 (0.002)	
Female	-19.09 (<0.001)			-9.98 (0.002)			-14.39 (0.026)	-9.57 (<0.001)
Smoking Previous Current								-6.82 (0.048) -9.80 (0.008)
Previous pulmonary TB							-17.69 (0.061)	
PLRS/asthma	-13.13 (<0.001)	-13.09 (0.044)		-12.84 (<0.001)				
RUDS				-9.57 (0.04)				
Depression		-26.32 (0.010)		-10.95 (0.033)	-13.98 (0.002)	-25.24 (<0.001)	-21.85 (0.038)	-19.54 (<0.001)
Anxiety			-21.50 (<0.001)		-7.38 (0.069)			-17.32 (<0.001)
Cardiac disease	-10.72 (0.065)							
R^2	0.33	0.08	0.08	0.06	0.08	0.06	0.09	0.20

PF – Physical Functioning, RP – Role Physical, BP – Bodily Pain, GH – General Health, V – Vitality, SF – Social Functioning, RE – Role Emotional, MH – Mental Health.
RUDS – Reactive Upper Airways Dysfunction Syndrome

Logistic regression models demonstrated a clinically significant decline in scores of SF-36 health scales, Role Physical (OR = 1,97; CI 1,09 - 3,55) and General Health (OR= 7.07; CI 2,88 - 17,35) at year 1 and General Health (OR=3.50; CI 1,39 - 8,79) at year 6, in residents with PLRS and/or asthma (Table 4). Similarly, residents with PLRS and/or asthma with co-existing RUDS experienced a clinically significant decline in their HRQoL for the SF-36 scale General Health (OR=7.04; CI 1.61- 30.7) at year 1 and General Health (OR=8.58; CI 1, 10 – 65, 02) at year 6. The model with RUDS only, yielded similar results to the combined model since RUDS did not occur on its own (data not shown).

Discussion

This study has shown that residents who developed PLRS and /or asthma, as a result of exposure to SO_2 vapours, in an environmental disaster, scored significantly lower ($p<0.05$) for the SF-36 scales Physical Functioning, Role-Physical and General Health, compared to residents without PLRS and/or asthma 6 years after the incident. PLRS and/or asthma, was found to be strong determinant of physical health as opposed to mental health related quality of life. Residents who had co-morbid RUDS, scored significantly lower ($p=0.04$) for the SF-36 subscale General Health.

In this study, residents with PLRS and/or asthma reported lower General Health perception, in that they perceived their health to be poorer and believed that, it would get worse over time. PLRS and/or asthma was also associated with lower scores in Physical Functioning and Role Physical indicating that they experienced limitations in performing physical activities, daily activities of living or work, at 6 years. Furthermore, this study found that residents with PLRS and/or asthma were more likely to experience (>5 points from baseline) decline in their HRQoL for the SF 36 scales Role physical (OR=1, 97) and General Health (OR = 7, 07) at year 1 and General

Table 4. Determinants of decline in health-related quality of life in physical health according to SF-36 subscale scores of Macassar residents at 1year and 6 years after fire (n=246) in multivariate logistic regression models

	Decline in SF – 36 scores after 1 year Odds ratio (CI)			Decline in SF – 36 scores after 6 years Odds ratio (CI)		
	Role Physical	**Bodily pain**	**General health**	**Role physical**	**Bodily pain**	**General health**
PLRS/asthma	**1.97 (1.09 – 3.55)***	**1.24 (0.70 – 2.21)**	**7.07 (2.88 – 17.35)*****	**1.59 (0.89 – 2.84)**	**1.05 (0.59 – 1.84)**	**3.50 (1.39 – 8.79)****
PLRS/asthma and RUDS	**1.82 (0.84 – 4.15)**	**0.95 (0.42 – 2.13)**	**7.04 (1.61 – 30.7) ****	**1.65 (0.74 – 3.79)**	**0.84 (0.38 – 1.84)**	**8.58 (1.10 – 65.02)***

Each odds ratio is a separate model adjusted for age, sex, smoking status, pulmonary TB, depression and cardiac disease. *: $p<0.05$; **: $p<0.01$; ***: $p<0.001$

RUDS – Reactive Upper Airway Dysfunction Syndrome

Health (OR=3,50) at year 6. Thus, residents with PLRS and/or asthma experienced significant impairment in physical health at 6 years after the fire and over time. This may be explained by the high proportion of moderate to severe asthmatics (46%) relative to mild asthmatics (37%), in this study. Previous studies have demonstrated significantly greater impairment in HRQoL in physical health in severe to moderate asthmatics compared to mild asthmatics [8,9,10,11].. Muraki et al reported that patients with severe asthma experienced poorer HRQoL for the SF-36 scale Physical Functioning. [11] Similarly, other studies have also reported effects on physical health among asthmatics. [9, 10] Contrary to our findings, Osman et al's study of mild asthmatics reported both physical and mental health related HRQoL effects. [31]. However, Sundberg et al found no significant difference in decline in the SF-36 HRQoL among asthmatics. [32] It is argued that individuals with chronic disease such as asthma employ coping mechanisms, in order to deal with their asthma, by reducing their expectations for their heath and activities. [33] Thus, it may well be the case that residents with severe to moderate PLRS and/or asthma may have adapted to the physical restrictions caused by their asthma, by reducing their expectations of their health and physical activities, thereby creating a more positive outlook on life, and therefore were less likely to mental health related HRQoL effects as reported by studies of mild asthmatics. Further research is therefore needed in this area, to assess the relevance of the decline in HRQoL over time, as observed in our current study.

In this study, residents with persistent upper (RUDS) and lower airway symptoms reported poorer General Health perceptions at year 6 and over time. Leynart et al, found that patients with allergic rhinitis experienced greater impairment in their mental health, with significantly lower scores for the SF-36 scales General Health and Vitality and for the Mental Component Summary (MCS). However, in patients with both allergic rhinitis and asthma, patients

experienced greater impairment in their physical health, particularly in the SF-36 domains of Physical Functioning and Role Physical. Hence, asthma was found to further impair HRQoL in patients with both allergic rhinitis and asthma. [23] Kalpaklioglu and colleagues found that patients with asthma experienced significant impairment in their physical health. Moreover, in patients with both allergic rhinitis and asthma there appeared to no further impairment of HRQoL. Hence, allergic rhinitis did not impair HRQoL in patients with asthma. [22] In our study PLRS and/or asthma and RUDS (irritant form) occurred at the same time, hence the pathophysiology was different from allergic rhinitis and asthma. This may well account for the differences in the findings of this study from previous studies.

In this study, sex/gender was found to be strongly associated with poorer HRQoL. It is argued that women experience higher morbidity and poorer health perceptions than men; due to the social constructions of sex/gender i.e. gender roles and traits.[34] Indeed studies that have assessed gender differences in HRQoL among asthmatics have found asthmatic women to have significantly poorer HRQoL compared to asthmatic men. It has been reported that these sex/gender differences are likely to be explained by '*subjective disease parameters'*. Despite higher pulmonary function levels in women compared to men, women report more severe dyspnoea, and a higher use of medication. Given that women experience far greater psychological disorders, such as mood and anxiety disorders, compared to men, and that dyspnoea is one of the main symptoms of anxiety disorders, suggests that women may have more severe asthma in terms of '*subjective disease parameters'*.[15]

Some of the strengths of this study should be mentioned. This study used a well-validated instrument, the SF-36 health survey, which enabled the assessment of both mental and physical dimensions of health, among the Macassar residents. Furthermore, this was an

opportunistic study of a rare event. The Macassar disaster was the first of its kind and provided the opportunity to assess the impact of co-existing PLRS and/or asthma and RUDS on HRQoL in residents exposed to SO_2 at such a large scale.

The results of this study are subject to several limitations. Firstly, 'self – selection' bias was one of the limitation in this study, given that the entire study population was self-referred and not randomly selected, and may have been driven by other factors such as compensation. Secondly, recall bias may have occurred, given that the residents were asked 6 years after the interviewees were unaware of the hypothesis of the study and therefore were unlikely to answer questions according to the expected outcome. Furthermore, recall bias is considered unlikely, given that reporting would not have been differentially distributed among residents with and those without PLRS and/or asthma. Nevertheless, the results for year 6 are likely to be more robust, given that HRQoL measured at 6 years after the fire was during the year that the survey was conducted. Finally, the study was potentially subject to confounding bias, given that data for socio-economic status (education, occupation and income) and health care utilisation was not collected. However, as indicated previously, these variables were considered not to be differentially distributed amongst the residents with PLRS and/or asthma and those without PLRS and/or asthma, and were not considered to have impacted on the results in a substantial way.

The findings of this study highlight the public health implications in the long term. Hence, health care providers need to be cognisant of the impairment in physical health in residents with PLRS and/or asthma. Consideration needs to be given to physical limitations experienced by the residents affected by the disaster. These could include transport to health clinics and ensuring that the residents do not engage in physically demanding paid work. This

would enable the residents to overcome some of the physical limitations endured as a result of their asthma. Furthermore, residents may require counselling, in order to overcome the poor perceptions of their general health. Counselling may allow residents to adapt to the physical restriction caused by their asthma, by encouraging the residents to have more realistic expectations of their health and thereby improving their perceptions of general health.

Conclusion

In conclusion, this study highlights the long-term adverse impact on HRQOL among residents reporting lower and upper airways disease following a sulphur stockpile fire disaster. Future studies need to focus on assessing the impact of irritant induced rhinitis and asthma on HRQoL among individuals affected by irritant chemical exposures following accidental spills and other disasters.

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SECTION D. APPENDICES

Appendix 1: Macassar Questionnaire

Macassar – AECI fire disaster medical claimants project, screening questionnaire - 2001

A. Demographic information

Date:_____

Respondent: ____ Claimant ____ Parent or Guardian _____

Claim no. _____

Personal information:

Surname: _____

First name: _____

ID No. _____

Address: _____

_____

Phone No: (H)_____(W)_____

Gender: ____ Female ____ Male

Date of Birth: ____/____/____ Age: _____

B. Exposure information

1. What was your address at the time of the fire?

_____

2. Where you in the Macassar area at time of the fire? **Yes**__or _____**No** If **No,** when did you return to Macassar ?

Datum_____

Day_____

Time_____

3. If **Yes**, in which area or address were you when you became aware of the fire?_____

3.1What was the time? _____

3.2 Were you ____ indoors? _____ outside at time of detection?

Please list your movements in the Maccasar area during the first 36 hours after the fire was reported, from 6am (16/12/95) to 6pm (17/12/95).

Date	**Day**	**Time in**	**Time out**	**Inside (I)** **Outside (O)** **Both (B)**	**AreaAddress**	**Smelled anything**	**Exposure time**

C. Health effects

What were your main medical symptoms that you experience as a result of exposure to the smoke from the fire?

a) _____

b) _____

c) _____

Nature of symptoms

Please indicate whether you have/had the following symptoms on a regular basis (almost every day).

0 = No symptoms
1 = Symptoms present
2 = Symptoms present, Better
3 = Symptoms present, No change
4 = Symptoms present, Worse

Symptoms	**Before the fire**	**Within 2 weeks after the fire**	**At 1 month after the fire**	**At 1 year after the fire**	**During the past 4 weeks**
Constitutional Dizziness					
Headache					
Fatigue					
Gastro-intestinal Nausea/Vomiting					
Diarrhoea					
Stomach pain/ cramps					

Symptoms	Before the fire	Within 2 weeks after the fire	At 1 month after the fire	At 1 year after the fire	During the past 4 weeks
Skin Burning skin					
Skin rash					
Eyes Burning/itchy eyes					
Watery eyes					
Blurred vision					
Nose/Throat Burning nose					
Decreased sense of smell					
Hoarse voice					
Burning, itchy, sore throat					
Respiratory Chest pain					
Cough					
Shortness of breath					
Tight chest					
Wheeze					
Phlegm in your chest					
Asthma					
Bronchitis					
Other lung problems					

Symptoms	Before the fire	Within 2 weeks after the fire	At 1 month after the fire	At 1 year after the fire	During the past 4 weeks
Neuro-Psych Can't concentrate					
Difficulty remembering things					
Feeling downhearted or sad or depressed					
Anxious					
Having "nerves" troubles					
Other symptoms Specify:_____ _____ _____					

2.1More details of other symptoms:
_____
_____

2.2 Comments about any of the specific symptoms mentioned above:
_____
_____

2.3 Have you ever been treated for Tuberculosis? ___ Yes ___ No

2.3.1 If Yes, when? (Year) _____
2.3.2 Have you completed you course of treatment? ___ Yes____No

2.4 Current Medications:

a) _____
b) _____
c) _____
d) _____

2.5 Smoking history: ___Current smoker ___ Ex-smoker ___ Never

If current, how many cigarettes per day _____

3. Reproductive concerns

	Yes	No
3.1 Have you had a child in the last 5 years?	□	□

If ***Yes,*** answer the next questions:

3.1.1 Did your child have a low birth weight?	□	□

What was the weight? _____ grams

3.1.2 Did your child have a birth defect?	□	□

Please describe

_____
_____

3.2 In the last 5 years, have you attempted to havea child without success?

□ □

Please describe

_____
_____

D. Health services used

Please provide the following information:

1. Which health service providers (doctors, nurses, psychologists, clinics, hospitals, traditional healers) have you consulted before 16 December 1995, and the reason for the consultations:

Date	Doctor/Hospital/Clinic	Reason

Note: Append all medical certificates, special tests, reports to this page

2. Which health service providers (doctors, nurses, psychologists, clinics, hospitals, traditional healers) have you consulted after 16 December 1995, and the reason for the consultations:

Date	Doctor/Hospital/Clinic	Reason

Note: Append all medical certificates, special tests, reports to this page

3. If no health service providers (doctors, nurses, psychologists, clinics, hospitals, traditional healers) were consulted after 16 December 1995 state the reason for not doing so?

_____

_____

4. Is there any other information you would like to share with us concerning your health problems that may have resulted from exposures during the fire?

_____

_____

5. According to your opinion, which part of your body or organs have been affected or damaged by the fire for which you have utilized health care facilities?

_____

_____

E. Physical examination

→ *Claimant to undress to waist (shirt or top off) and remove shoes*

0. Height_____ Weight_____

1. General *(pallour, cyanosis, wasting, etc.)*:
_____

2. Eyes: _____
(note any conjunctival irritation, erosions, lacrimation, scarring, or corneal scarring)

3. Eardrums: _____

4. Nose: _____
(note the condition of mucosa, erosions, allergic characteristics)

5. Mouth and throat: _____

6. Skin: _____
(note any lesions and history of each, especially in relation to the sulphur fire)

7. CVS: _____
Pulse_____BP_____Heart sounds_____

8. Chest: _____
Rate_____Air entry_____Wheezes / Crackles_____
Peak flow_____

9. Abdomen: _____
_____

10. Mental state: _____
(note appearance, behaviour, speech, language use and mood)

11. Other findings:
_____
_____

F. Overall medical assessment

1. The symptoms of the client relate to:

Respiratory	
Dermatological	
Ophthalmic	
Psychological	
Obstetrical/Gynaecological	
Ear/Nose/Throat	
Paediatric	
Other	

2. The following medical reports and/or certificates were available and perused:

a)
b)
c)
d)

Nurse's comments:

_____

_____

FOLLOW UP: Please include indication for referral

	Refer to Medical Reference Panel:	
	Refer to General Practitioner Panel:	
	Refer to Lawyer:	
	Refer to Other Primary Healthcare Provider:	
	Other e.g. advice office:	

Appendix 2: Medical Outcomes Study (SF-36) Questionnaire

Please answer the following questions that relate to the quality of your health and life before and after the fire.

Instructions: *Please cross only one box.* ***For children****, for any question where the word* ***"work"*** *appears, replace it with the word* ***"school".***

1. In general, would you say your health is:

   □ Excellent □ Very Good □ Good □ Fair □ Poor

2. Compared to one year ago, how would you rate your health in general now? **(Cross one)**

   □ Much better now than one year ago
   □ Somewhat better now than one year ago
   □ About the same as one year ago
   □ Somewhat worse now than one year ago
   □ Much worse than one year ago

3. Have you had any of the following problems with your work or other regular daily activities as a result of your **physical** health.

1 = Yes **2 = No**		Before the Fire	At 1 month After the fire	At 1 year after the fire	During the past 4 weeks
a.	Cut down the amount of time you spent on work (school) or other activities.				
b.	Accomplished less than you would like.				
c.	Were limited in the kind of work (school) or other activities.				

d.	Had difficulty performing the work (school) or other activities (e.g., it took extra effort).				

4. Have you had any of the following problems with your work or other regular daily activities as a result of your **emotional** health (such as feeling depressed or anxious)?

1 = Yes **2 = No**		Before the Fire	At 1 month after the fire	At 1 year After the fire	During the past 4 weeks
a.	Cut down the amount of time you spent on work (school) or other activities.				
b.	Accomplished less than you would like.				
c.	Were limited in the kind of work (school) or other activities.				
d.	Had difficulty performing the work (school) or other activities (e.g., it took extra effort).				

5. Please answer the following questions according to the extent that you have experienced the following:

1= Not at all	4= Quite a bit
2= Slightly	5 = Extremely
3= Moderately	

		Before the Fire	At 1 month after the fire	At 1 year After the fire	During the past 4 weeks
a.	To what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, partners neighbours, or groups?				
b.	How much bodily pain have you had?				

c.	How much did bodily pain interfere with your normal work (including both work outside the home and housework?)				

6. These questions are about how you feel and how things have been with you since the time of the fire. For each question, please give the one answer that comes closest to the way you have been feeling and for how much of the time: *Please mark the appropriate box to indicate the response.*

1= All of the time	4= Some of the time
2= Most of the time	5= A little of the time
3= A good bit of the time	6= None of the time

		Before the Fire	At 1 month after the fire	At 1 year after the fire	During the past 4 weeks
a.	Did you feel full of pep?				
b.	Have you been a very nervous person?				
c.	Have you felt so down in the dumps that nothing could cheer you up?				
d.	Have you felt calm and peaceful?				
e.	Did you have a lot of energy?				
f.	Have you felt downhearted and blue?				
g.	Did you feel worn out?				
h.	Have you been a happy person?				
i.	Did you feel tired?				
j.	How much has your physical or emotional health interfered with your social activities (like visiting with friends, relatives interaction with, etc.)?				

7. How **TRUE** or **FALSE** is each of the following statements for you?

1= Definitely True	4= Mostly False
2= Mostly True	5= Definitely False
3= Don't Know	

		Before the Fire	At 1 month after the fire	At 1 year after the fire	During the past 4 weeks
a.	I seem to get sick a little easier than other people.				
b.	I am as healthy as anybody I know.				
c.	I expect my health to get worse.				
d.	My health is excellent.				

8. The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much? *Please mark the appropriate box to indicate the response.*

		YES, limited a lot.	*YES, limited a little.*	*NO, not limited at all.*
a.	Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports.	1	2	3
b.	Moderate activities, such as moving a table, pushing a vacuum cleaner, riding a bicycle or working in the garden.	1	2	3
c.	Lifting or carrying groceries.	1	2	3
d.	Climbing several flights of stairs.	1	2	3
e.	Climbing one flight of stairs.	1	2	3
f.	Bending, kneeling, or stooping.	1	2	3
g.	Walking more than a Km.	1	2	3
h.	Walking several blocks.	1	2	3
i.	Walking one block.	1	2	3

Appendix 3: Patient Information Sheet

Environmental And Host Factors Associated With Persistent Lower Respiratory Tract Symptoms Or Asthma Following Acute Environmental Exposure To Sulphur Dioxide ($S0_2$).

Good Day,

We are **Roslynn Baatjies** and **Sister F Omar** from the University of Cape Town medical school. We are investigating the quality of life and respiratory health of residents in Macassar following the exposure to sulphur dioxide from the fire disaster in 1995. The aim of the study is to investigate the environmental factors (exposure to sulphur dioxide) associated with persistent lower respiratory (chest) symptoms among residents acutely exposed to the sulphur vapours. We would be most grateful if you would consider participating in this study.

Title of research project

Environmental and host factors associated with persistent lower respiratory tract symptoms or asthma following acute environmental exposure to sulphur dioxide ($s0_2$).

Description of the research project

If you agree to participate you will be asked to complete the following tests:

a) Complete a questionnaire.
An occupational health nurse, Sister F Omar, a member of our study team will interview you in privacy to complete the questionnaire. You will be asked questions about any breathing or chest problems, other medical questions, and where you were at the time of the fire.

b) Medical examination: An occupational health nurse, will perform a physical examination at the Macassar clinic to determine your overall health status and the presence of any illness. If you have any respiratory problems you will be referred to a pulmonologist for further evaluation.

c) Lung function/Breathing tests
You will be asked to blow several times into a machine which measures how well your lungs are working and detects whether you have asthma.

d) Confidentiality of information collected
Your name will not appear in any reports on this study. The records of questionnaires, examinations and breathing tests will be kept completely confidential and will be seen only by members of the study team.

e) Withdrawal from study
Your participation in this study is completely voluntary and you are free to withdraw from the study at any time without penalty.

f) Risks and discomforts of the research

i) From the questionnaire and breathing tests

There are no risks from completing the questionnaire. There is a small chance that the initial breathing test could cause you to become light-headed or faint. Having you complete the test in a seated position under the observation of trained personnel greatly reduces the chance of your having such a problem.

ii) From the examination

There are no risks from the examination.

g) Expected benefits to you and to others

You will be given a written copy of all your test results along with an explanation of what they mean, unless you tell us that you do not wish to receive this. The results will be given to your legal representative as well, to process your claim for compensation for the health effects suffered as a result of the fire.

h) Costs to you resulting from participation in the study

The study is offered at no cost to you.

i)Contact person.

You may contact one of the following persons for answers to further questions about the research, your rights, or any injury you may feel is related to the study.

University of Cape Town Researchers:

Dr. Mohamed Jeebhay, Telephone No. (021) 406-6309

Roslynn Baatjies/Sister Omar, Telephone No.: (021) 406-6665

Appendix 4: Consent Form

Environmental And Host Factors Associated With Persistent Lower Respiratory Tract Symptoms Or Asthma Following Acute Environmental Exposure To Sulphur Dioxide ($S0_2$).

STUDY NO. _____

Consent of the participant

I have read the information given above, or it has been read to me. I understand the meaning of this information, Dr./Mr./Ms.

_____

has offered to answer any questions concerning the study. By signing this form, I hereby consent to participate in the study.

Consent for medical release of documents

I_____ hereby consent to my legal representative, _____ and /or the medical team appointed by my legal representatives obtaining any medical records, reports or investigations pertaining to my medical history arising from the sulphur fire disaster in December 1995, from any doctor, hospital, clinic or other health professional. I also consent to any other medical information being released to the abovementioned that may be of relevance to my health problems prior to December 1995.

Documentation of the consent

One copy of this signed document will be kept together with our research records for this study. A copy of the information sheet about the study will be given to you to keep.

I understand that I am free to withdraw from the study at any time without penalty. I also understand that the records of questionnaires, examinations and breathing tests will be kept completely confidential and will be seen only by members of the study team.

_____ _____

Printed name of participant Signature, Mark, or Thumb Print

_____ _____

Interviewer's name (Print) Signature

DATE: _____

Appendix 5. Additional Tables

Table 1. Demographic and health-related characteristics of Macassar residents stratified according to the presence of persistent lower respiratory symptoms and/or asthma prior to and at 1 year and 6 years after the fire (n=246)

	PLRS and/or asthma after the fire			No PLRS and/or asthma after the fire		
	Prior to fire (n=24)	**Year 1 (n=74)**	**Year 6 (n=74)**	**Prior to fire (n=222)**	**Year 1 (n=172)**	**Year 6 (n=172)**
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Demographic characteristics						
Age (years): Mean ± SD	43 ± 13.1	44 ± 11.9	49 ± 11.9	41 ± 12.7	42 ± 13.0	47 ± 13.0
Female	16 (66.6)	51(68.9)	51(68.9)	146 (65.7)	111(64.5)	111(64.5)
Smoking status						
Never	10 (41.6)	30 (40.5)	30 (40.5)	91 (40.9)	71 (41.2)	71 (41.2)
Previous	11 (45.8)	29 (39.1)	29 (39.1)	70 (31.5)	52 (30.2)	52 (30.2)
Current	3 (12.5)	15 (20.2)	15 (20.2)	61 (27.4)	49 (28.4)	49(28.4)
Previous Pulmonary Tuberculosis	2 (8.3)	12 (16.2)	13 (17.5)	23(10.3)	16 (9.3)	16 (9.3)
Current treatment for asthma	21(87.5)	45(60.8)	45(60.8)	0 (0)	0 (0)	0 (0)
Other chronic diseases						
Hypertension	3 (12.0)	12 (16.2)	17 (22.9)	25 (11.2)	36 (20.9)	44 (25.5)
Cardiac disease	2 (8.3)	3 (4.0)	8 (10.8)	4 (1.8)	8 (4.6)	11 (6.3)
Diabetes	2 (8.3)	11 (14.8)	10 (13.5)	7 (3.1)	9 (5.2)	12 (6.9)
Arthritis	1 (4.1)	5 (6.7)	3 (4.0)	21 (9.4)	27 (15.6)	22 (12.7)
Depression	0 (0.0)	4 (5.4)	8 (10.8)	10 (4.5)	12(6.9)	15 (8.7)
Anxiety	1 (4.1)	9 (12.1)	10 (13.5)	10 (4.5)	15 (8.7)	19 (11.0)

Table 2. Health- related quality of life SF-36 scale scores of Macassar residents prior to and at 1 year and 6years after the fire (n=246)

	Mean ± SD	Median (IQR)	p-value
Role Physical			
Prior to fire	94 ± 23.0	100 (100-100)	
Year 1	66 ± 46.3	100 (0-100)	**<0.001**
Year 6	44 ± 48.3	0 (0-100)	
Bodily Pain			
Prior to fire	92 ± 15.2	100 (78-100)	
Year 1	76 ± 26.7	78 (55-100)	**<0.001**
Year 6	64 ± 30.9	78 (33-100)	
General Health			
Prior to fire	75 ± 18.1	81 (69-88)	
Year 1	39 ± 25.3	31(19-56)	**<0.001**
Year 6	33 ± 24.8	25(13-50)	
Vitality			
Prior to fire	82 ± 18.1	85 (75-100)	
Year 1	61 ± 22.9	60 (45-80)	**<0.001**
Year 6	51 ± 20.6	50 (40-65)	
Social Functioning			
Prior to fire	88 ± 16.3	100 (80-100)	
Year 1	69 ± 25.5	68 (48-80)	**<0.001**
Year 6	60 ± 28.6	65 (43-80)	
Role Emotional			
Prior to fire	95± 21.5	100 (100-100)	
Year 1	72 ± 44.6	100 (0-100)	**<0.001**
Year 6	49 ± 49.3	50 (0-100)	
Mental Health			
Prior to fire	82± 19.0	85 (75-100)	
Year 1	61± 22.9	60 (45-80)	**<0.001**
Year 6	51 ± 20.6	50 (40-65)	

Freidman test

Table 3. Health- related quality of life SF-36 scale scores of Macassar residents Sf-36 stratified according to the presence of persistenct lower respiratory symptoms and/or asthma prior to and at 1 year and at 6 years after the fire (n=246)

	PRIOR TO FIRE		YEAR 1		YEAR 6	
	PLRS/asthma (n=24)	ºPLRS/asthma (n=222)	PLRS/asthma (n=74)	ºPLRS/asthma (n=172)	PLRS/asthma (n=74)	ºPLRS/asthma (n=172)
Physical Functioning	N/D	N/D	N/D	N/D	24±25.1	39±28.5
Mean ± SD					15(0-35)	35(18-35)
Median (IQR)					**<0.001**	
p-value						
Role Physical						
Mean ± SD	79 ± 41.4	96 ±19.6	55 ± 48.7	71 ± 44.6	33 ± 45.9	48 ± 48.7
Median (IQR)	100 (100-100)	100 (100-100)	100 (0-100)	100(0-100)	0(0-100)	0(0-100)
p-value	**0.004**		**0.011**		**0.024**	
Bodily Pain						
Mean ± SD	86 ± 18.4	92 ± 14.8	75 ± 27.5	77 ± 26.4	67 ± 30.8	67± 31.0
Median (IQR)	100(78-100)	100(78-100)	78(55-100)	78(55-100)	78(33-100)	78(33-100)
p-value	0.070		0.8456		0.797	
General Health						
Mean ± SD	63 ± 21.1	76 ± 17.2	24 ± 14.1	44 ± 26.1	24 ± 17.8	37 ± 25.9
Median (IQR)	81(69-88)	69 944-81)	19 (13-31)	38 (25-69)	19 (13-32)	32(13-56)
p-value	**0.002**		**< 0.001**		**< 0.001**	
Vitality						
Mean ± SD	74 ± 19.4	83 ± 17.6	58 ± 23.3	62 ± 21.9	50 ± 20.1	52 ± 20.6
Median (IQR)	85 (75-100)	75 (55-93)	55 (40-80)	60 (45-78)	50 (35-65)	50 (40-65)
p-value	**0.008**		0.148		0.685	
Social Functioning	83 ± 18.2	89 ± 16.0				
Mean ± SD	100(80-100)	84 (68-100)	65 ± 26.3	70 ± 25.1	57 ± 28.8	62 ± 28.2
Median (IQR)	**0.049**		68(48-80)	68(51-100)	55 (33-80)	43(68-80)
p-value			0.149		0.239	
Role Emotional	83 ± 38.0	96 ± 18.6	68 ± 46.5	74 ± 43.8		
Mean ± SD	100 (100-100)	100 (100-100)	100(0-100)	100(0-100)	46 ± 49.2	51± 49.1
Median (IQR)	**0.005**		0.330		0(0-100)	63(0-100)
P-value					0.535	
Mental Health	83 ± 18.7	83 ± 19.1				
Mean ± SD	88 (72-100)	90(70-100)	69 ± 24.0	68 ± 24.2	62 ± 26.9	63 ± 24.9
Median (IQR)	0.926		72 (48-88)	70(52-90)	60(36-88)	60(44-84)
p- value			0.986		0.8832	

Mann-Whitney test. ◦ PLRS/asthma = No PLRS/asthma, N/D : not done

Table 4. Health- related quality of life SF-36 scale scores of Macassar residents according to demographic and chronic diseases characteristics at 6 year after the fire (n= 246).

	RP	BP	GH	PF	V	SF	RE	MH
Age								
24 – 38	61±46.8	75±29.9	36±24.6	50±27.8	54±23.0	64±28.4	66±46.0	65±25.8
	100(0-100)	89(55-100)	31(13-57)	48(28-73)	50(40-73)	69(43-80)	100(0-100)	64(44-92)
39 – 46	43±47.5	70±30.0	36±28.0	38±25.3	54±19.4	63±30.3	50±50.1	63±26.3
	0(0-100)	78(33-100)	25(13-63)	35(20-55)	55(40-65)	65(43-1000	25(0-100)	60(44-92)
47 – 57	35±47.0	61±31.7	26±22.5	24±24.8	48±16.5	54±25.9	41±49.0	58±24.9
	0(0-100)	60(33-1000	22(13-38)	15(5-40)	50(45-55)	55(35-75)	0(0-100)	60(36-80)
58 – 76	32±47.3	59±30.2	32±22.1	21±25.6	47±21.0	58±28.4	38±32.2	63±24.0
	0(0-100)	53(33-100)	25(13-38)	15(0-30)	45(30-60)	56(35-80)	0(0-100)	60(48-80)
**p-value	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
Sex								
Female	41±47.8	64±31.1	29±21.4	27±28.1	50±19.7	59±28.4	44±48.7	58±24.1
	0(0-100)	74(33-100)	25(13-8)	25(5-40)	50(40-65)	60(40-80)	0(0-100)	56(40-76)
Male	48±49.0	72±29.8	40±28.4	48±32.4	55±21.6	63±28.1	60±48.6	70±25.8
	25(0-100)	78(33-100)	31(13-3)	45(20-78)	50(43-68)	68(43-80)	100(0-100)	74(52-92)
*p-value	0.192	**0.04**	**0.008**	**< 0.001**	0.072	0.285	**0.010**	**< 0.001**
Smoking								
Never	45± 47.7	67± 30.6	32±22.5	37±28.1	54±20.9	60±26.4	53±48.8	66±25.2
	0(0-100)	78(33-100)	25(13-44)	35(15-55)	50(40-65)	60(43-80)	100(0-100)	64(48-92)
Previous	42±48.8	66±31.9	33±26.8	28±28.9	49±20.8	61±29.2	47±50.2	61±24.0
	0(0-100)	78(33-100)	25(13-50)	20(0-45)	45(40-65)	60(43-88)	0(0-100)	64(44-80)
Current	45±49.0	67± 30.5	34±25.0	38±27.3	49±18.9	60±30.7	47±49.5	56±26.1
	0(0-100)	78(33-100)	28(13-56	35(15-53)	50(40-58)	68(26-80)	0(0-100)	52(34-80)
**p- value	0.952	0.9943	0.932	0.220	0.260	0.955	0.590	**0.040**
Previous Pulmonary TB								
Yes	38 ± 48.0	59±30.0	29±28.0	31±28.4	29±28.0	59±28.2	36±47.9	61±27.2
	0(0-100)	55(33-78)	13(13-31)	30(0-55)	13(13-32)	68(35-80)	0(0-100)	60(36-88)
No	45±48.3	68±30.9	33±24.0	35±28.4	34±24.0	60±28.5	51±49.4	63±25.1
	0(0-100)	78(33-100)	25(13-50)	30(10-50)	25(13-50)	60(43-80)	75(0-100)	60(44-84)
*p-value	0.4899	0.1017	0.120	0.453	0.1202	0.882	0.120	0.621
Current treatment for asthma								
Yes	31± 45.5	70±29.6	23±15.5	24±25.9	50±21.8	57±27.0	46±49.4	61±28.4
	0(0-100)	78(33-100)	19(13-31)	15(0-40)	50(35-65)	55(43-80)	0(0-100)	56(36-88)
No	47±48.5	66±31.2	35±25.6	37±28.4	52±20.2	61± 28.7	50±49.4	63±24.6
	25(0-100)	78(33-100)	32(13-56)	35(15-55)	50(40-65)	68(43-80)	50(0-100)	60(44-84)
*p-value	**0.048**	0.436	**0.004**	**0.003**	0.748	0.334	0.657	0.540
Hypertension								
Yes	36±47.7	62±29.0	32±23.7	26±26.6	32±23.7	59±26.9	46±49.6	58±23.2
	0(0-100)	63(33-100)	25(13-38)	15(0-40)	25(13-38)	60(35-80)	0(0-100)	52(44-76)
No	46± 48.3	68± 31.0	34±24.8	37±28.4	34±24.8	61 ±28.9	50±49.3	63±25.9
	25(0-100)	78(33-100)	25(13-57)	30(15-55)	25(13-56)	68(43-80)	50(0-100)	64(44-88)
*p- value	0.141	0.147	0.784	**0.003**	0.784	0.537	0.501	0.194
Cardiac disease								
Yes	16±37.4	54±29.2	25±20.8	13±17.4	48±19.2	49±26.2	24±41.2	61±24.0
	0(0-0)	33(33-90)	13(13-38)	5(0-25)	45(35-60)	43(23-68)	0(0-25)	64(48-80)
No	46±48.4	68±30.8	33±24.7	36±28.4	51±20.6	61±28.4	52±49.4	63±25.4

	0(0-100)	78(33-100)	31(13-50)	30(15-55)	50(40-65)	68(43-80)	100(0-100)	60(44-88)
*p-value	**0.007**	0.073	0.120	**<0.001**	0.457	0.070	**0.030**	0.833
Diabetes								
Yes	27± 45.5	54±30.0	28±21.7	21±25.3	28±21.7	54±29.9	47±50.1	66±24.4
	0(0-100)	33(33-88)	19(13-38)	13(0-30)	19(13-38)	45(23-80)	12.5(0-100)	64(48-84)
No	45±48.3	68±30.7	34±24.8	35±28.4	33±24.8	61±28.2	50±49.4	62±25.4
	0(0-100)	78(33-100)	25(13-50)	30(13-55)	25(13-50)	68(43-80)	50(0-100)	60(44-88)
*p-value	0.0848	**0.042**	0.396	**0.009**	0.396	0.280	0.845	0.430
Depression								
Yes	18.4 ± 38.5	50.8±27.0	21±18.9	25±23.5	21±18.9	37±24.2	26±44.8	38±19.0
	0(0-0)	33(33-78)	13(13-31)	25(0-40)	13(13-31)	33(23-45)	0(0-100)	32(24-48)
No	46±48.4	68±30.8	34±24.7	35±28.7	34±24.7	63±27.8	52±49.2	65±24.6
	0(0-100)	78(33-100)	31(13-50)	30(10-55)	31(13-50)	68(43-80)	100(0-100)	64(48-88)
*p-value	**0.013**	**0.008**	**0.004**	0.143	**0.004**	**< 0.001**	**0.016**	**<0.001**
Anxiety								
Yes	31±45.6	48±27.5	24±21.0	27±25.0	24±21.0	49±25.5	37±48.4	41±17.2
	0(0-100)	33(33-65)	19(13-31)	20(5-40)	19(13-31)	45(23-68)	0(0-100)	40(24-52)
No	45±48.4	70±30.6	34±24.7	35±28.5	34±24.7	62±28.5	51±49.3	65±24.8
	0(0-100)	78(33-100)	31(13-50)	30(10-50)	31(13-50)	68(43-80)	50(0-100)	64(48-88)
*p-value	0.130	**<0.001**	**0.016**	0.148	**0.016**	**0.023**	0.122	**<0.001**
PLRS/asthma								
Yes	33±45.9	67±30.8	24±17.8	24±25.1	50±20.1	57±28.8	46±49.2	62±26.9
	0(0-100)	78(33-100)	18(19-31)	15(0-35)	50(35-65)	55(33-80)	0(0-100)	60(36-88)
No	48±48.7	67±31.0	37±25.9	39±28.5	52±20.6	62±28.2	51±49.5	62±24.6
	25(0-100)	78(33-100)	31(13-56)	35(18-55)	50(40-65)	68(43-80)	63(0-100)	66(44-84)
*p-value	**0.023**	0.797	**<0.001**	**<0.001**	0.684	0.239	**0.023**	0.883
Reactive Upper Airway Dysfunction Syndrome								
Yes	44±48.5	65±31.0	24±15.4	32±26.7	52±18.1	59±28.3	48±49.3	61±25.0
	0(0-100)	78(33-100)	25(13-31)	30(8-55)	50(40-65)	65(40-80)	100(0-100)	60(44-84)
No	44±47.5	75±29.1	34±25.4	35±28.6	53±20.8	62±29.2	48±49.3	67±26.6
	13(0-100)	94(55-94)	31(13-56)	30(10-50)	50(40-65)	65(43-88)	13(0-100)	72(44-92)
*p-value	0.965	0.074	0.108	0.817	0.542	0.648	0.310	0.230

***Mann-Whitney test or **kruskal-Wallis test. Abrevation; RP – Role Physical, BP – Bodily Pain, GH – General Health, V – vitality, SF – Social Functioning, RE – Role Emotional, MH – Mental Health.**

Table 5. Mean difference in the health- related quality of life SF-36 scale scores of Macassar residents stratified according to the presence of persistent lower respiratory symptoms and/or asthma 6 years after the fire (n=246)

Mean difference at year 1

	Role Physical		Bodily Pain		General Health	
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IRR)
PLRS/Asthma	-36 ± 46.8	0(-100 – 0)	-16 ± 23.9	0(-22.5 – 0)	-50 ± 26.2	-56(-75 - -31)
No PLRS/Asthma	-24 ± 42.9	0(-25 – 0)	-14 ± 25.0	0(-22.5 – 0)	-30 ± 30.3	-25 (-56 – 0)
p-value	**0.036**		0.383		**<0.001**	

	Vitality		Social Functioning		Role Emotional		Mental Health	
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)
PLRS/Asthma	-21 ±21.2	-17.5 (-35 – 0)	-23 ± 24.4	- 20 (-40 – 0)	-25 ±43.2	0(-50 – 0)	-15 ± 19.4	- 12(-24 – 0
No PLRS/Asthma	-21 ±22.2	-15 (-35 – 0)	-18 ±24.1	-13 (-33 – 0)	-22 ± 42.7	0 (0 – 0)	-14 ± 18.3	-8 (-22 – 0)
p-value	0.931		0.114		0.583		0.403	

Mean difference at year 6

	Role Physical		Bodily Pain		General Health	
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IRR)
PLRS/Asthma	-58±47.9	-100 (-100 – 0	-24 ± 27.6	-18(-5 – 0)	-50 ± 28.3	- 56 (-75 - - 25)
No PLRS/Asthma	-46±48.6	-25 (-100 – 0)	-24 ± 30.2	-15 (-45 – 0)	-38 ± 30.3	-37 (-63 - - 9)
p-value	0.098		0.983		**0.004**	

	Vitality		Social Functioning		Role Emotional		Mental Health	
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)
PLRS/Asthma	-31 ± 23.3	-30(-50 - -15)	-31 ± 28.0	- 28 (-58 – 0	-47 ± 49.3	0 (-100 – 0)	-23 ± 19.1	-16 (-40 – 0
No PLRS/Asthma	-29 ±23.1	-30 (-50 - -10)	-27 ± 28.3	- 23 (-45 – 0)	- 47 ± 49.2	0 (-100 – 0)	-19±.19.5	-12(-34-0)
p-value	0.431		0.276		0.812		0.768	

Mann-Whitney

Table 6. Determinants of health -related quality of life according to SF-36 subscale Physical Functioning in the Macassar residents 6 years after the fire (n=246) : Univariate and multivariate linear regression models

Predictors for Physical Functioning	Coefficient	95% C.I	p-value
Unadjusted models			
Gender	-21.05	- 28.10 - 14.00	< 0.001
Age	-0.95	-1.18 – - 0.678	< 0.001
Smoking			
- Previous vs. never	-8.88	-17.16 – 0.59	0.036
- Current vs. never	0.47	-8.40 - 9.34	0.917
Previous Pulmonary Tuberculosis	-4.01	-15.08 – 7.06	0.476
Current treatment for asthma	-13.06	-22.16 – -3.96	0.005
Hypertension	-11.50	-19.65 - -3.35	0.006
Cardiac diseases	-22.54	-35.63 – -9.46	0.001
Diabetes	-14.62	-27.01 - -2.23	0.021
Arthritis	-11.82	-23.56 - -0.09	0.048
Depression	- 9.93	-22.15 – 2.27	0.110
Anxiety	-8.31	-19.34 – 2.72	0.139
PLRS/asthma	-15.32	-22.87 – -7.77	<0.001
Reactive Upper Airway Dysfunction Syndrome	- 2.34	-12.96 – 8.27	0.664
Adjusted Model			
Age	-0.78	-1.02 - -0.55	<0.001
Gender	-19.09	-25.30 - -12.89	<0.001
PLRS/asthma	-13.13	-19.56 - -6.71	<0.001
Cardiac disease	-10.72	-22.11 – 0.66	0.065
Constant	89.18	77.12 – 101.25	<0.001

Table 7. Determinants of health -related quality of life according to SF-36 subscale Role Physical in the Macassar residents 6 years after the fire (n=246): Univariate and multivariate linear regression models

Predictors for Role Physical	Coefficient	95% C.I	p-value
Unadjusted models			
Gender	-7.60	-20.38 – 5.17	0.242
Age	-0.78	-1.24 - -0.31	0.001
Smoking			
- Previous vs never	-2.27	-16.51 – 11.96	0.754
- Current vs never	-0.02	-15.27 – 15.23	<0.001
Current treatment for asthma	-15.80	-31.69 – 0.063	0.051
Previous Pulmonary TB	-6.65	-25.47 – 12.16	0.487
Hypertension	-10.28	-24.29 – 3.72	0.149
Cardiac disease	-30.35	-52.79 - -7.92	0.008
Diabetes	-18.15	-39.32 – 3.01	0.093
Arthritis	4.67	-15.42 – 24.77	0.647
Depression	-27.93	-48.50 - -7.36	0.008
Anxiety	-14.47	-33.22 – 4.28	0.130
PLRS/asthma	-14.80	-27.92 - -1.69	0.027
Reactive Upper Airway Dysfunction Syndrome	-0.05	-18.12 – 18.00	0.995
Adjusted Model			
Age	-0.70	-1.169- -0.27	0.002
Depression	-26.32	-46.39 – -6.26	0.010
PLRS/asthma	-13.09	-25.85 – -0.34	0.044
Constant	85.35	62.58 – 108.11	<0.001

Table 8. Determinants of health -related quality of life according to SF-36 subscale Bodily Pain in the Macassar residents 6 years after the fire (n=246): Univariate and multivariate linear regression models

Predictors for Bodily Pain	Coefficient	95% C.I	p-value
Unadjusted models			
Gender	-8.22	-16.36 - -0.08	0.048
Age	-0.45	-0.75 – -0.15	0.003
Smoking			
- Previous vs never	-0.62	-9.75 – 8.49	0.892
- Current vs never	-0.32	-10.09– 9.45	0.948
Current treatment for asthma	21.47	9.71 – 33.23	<0.001
Previous Pulmonary TB	-4.01	-15.08 – 7.06	0.476
Hypertension	-5.92	-14.90 – 3.05	0.195
Cardiac disease	-13.34	-27.82 – 1.13	0.071
Diabetes	-14.56	-28.08 - -1.05	0.035
Arthritis	-16.68	-29.39 - -3.97	0.010
Depression	-17.56	-30.74 - -4.37	0.009
Anxiety	-21.47	-33.23 - -9.71	<0.001
PLRS/asthma	0.92	-7.56 – 9.40	0.831
Reactive Upper Airway Dysfunction Syndrome	-9.79	-21.9 – 1.89	0.095
Adjusted Model			
Anxiety	-21.50	-33.06- -9.93	< 0.001
Age	-0.45	-0.74 – -0.16	0.002
Constant	91.08	76.59 – 105.57	<0.001

Table 9. Determinants of health -related quality of life according to SF-36 subscale General Health in the Macassar residents 6 years after the fire (n=246): Univariate and multivariate linear regression models

Predictors for General Health	Coefficient	95% C.I.	p-value
Unadjusted models			
Gender	-11.04	-17.41 - -4.67	0.001
Age	-0.17	-0.41 – 0.06	0.152
Smoking			
- Previous vs never	1.29	-5.94 – 8.53	0.725
- Current vs never	2.25	-5.49 – 10.01	0.567
Current treatment for asthma	-12.5	-20.34 - -4.65	0.002
Previous Pulmonary TB	-4.33	-13.90 – 5.24	0.374
Hypertension	-1.68	-8.83 – 5.47	0.644
Cardiac disease	-8.45	-19.98 – 3.07	0.150
Diabetes	-5.18	-15.99 – 5.62	0.346
Arthritis	7.64	-2.53 – 17.83	0.141
Depression	-13.46	-23.94 - -2.98	0.012
Anxiety	-10.43	-19.93 - -0.94	0.031
PLRS/asthma	-13.31	-19.84 - -6.79	<0.001
Reactive Upper Airway Dysfunction Syndrome	-9.57	-18.68 - -0.45	0.040
Adjusted Model			
PLRS/asthma	-12.84	-19.19 – -6.49	<0.001
Gender	- 9.98	-16.16 – -3.8	0.002
Depression	-10.10	-21.01 - -0.89	0.033
Constant	44.59	39.27 – 49.90	<0.001

Table 10. Determinants of health -related quality of life according to SF-36 subscale Vitality in the Macassar residents 6 years after the fire (n=246) : Univariate and multivariate linear regression models

Predictors for Vitality	Coefficient	95% C.I.	p-value
Unadjusted models			
Gender	-5.04	-10.44 – 0.35	0.067
Age	-0.23	-0.43 – -0.03	0.019
Smoking			
- Previous vs never	-4.98	-10.98 – 1.01	0.103
- Current vs never	-4.45	-10.88– 1.98	0.174
Current treatment for asthma	-1.67	-8.34 – 4.98	0.62
Previous Pulmonary TB	1.50	-6.48 – 9.49	0.711
Hypertension	-6.03	-11.95 - -0.11	0.046
Cardiac disease	-3.07	-12.72 – 6.57	0.531
Diabetes	-5.87	-14.87 – 3.12	0.200
Arthritis	-2.07	-10.59 – 6.45	0.633
Depression	-16.49	-25.10 - -7.89	<0.001
Anxiety	-10.81	-18.68 - -2.93	0.007
PLRS/asthma	-1.89	-7.51 – 3.71	0.506
Reactive Upper Airway Dysfunction Syndrome	-1.42	-9.08 – 6.23	0.712
Adjusted Model			
Depression	-13.98	-22.81 – - 5.15	0.002
Age	-0.23	-0.42 – - 0.03	0.020
Anxiety	-7.38	-15.35 – 0.58	0.069
Constant	64.40	54.78 – 74.01	<0.001

Table 11. Determinants of health -related quality of life according to SF-36 subscale Social Functioning in the Macassar residents 6 years after the fire (n=246) :Univariate and multivariate linear regression models

Predictors for Social Functioning	Coefficient	95% C.I.	p-value
Unadjusted models			
Gender	-4.01	-11.54 – 3.51	0.295
Age	-0.24	-0.52 – 0.03	0.088
Smoking			
- Previous vs never	0.83	-7.55 – 9.21	0.845
- Current vs never	-0.47	-9.45 – 8.50	0.917
Current treatment for asthma	-4.5	-13.78 – 4.68	0.333
Previous Pulmonary TB	-0.89	-11.99 – 10.19	0.874
Hypertension	-2.05	-10.33 – 6.22	0.626
Cardiac disease	-12.13	-25.44 – 1.18	0.074
Diabetes	-6.79	-19.29 – 5.71	0.286
Arthritis	-2.42	-14.25 – 9.41	0.687
Depression	-25.24	-37.11 - -13.37	<0.001
Anxiety	-12.82	-23.79 - -1.84	0.022
PLRS/asthma	-4.74	-12.51 – 3.03	0.231
Reactive Upper Airway Dysfunction Syndrome	-2.46	-13.09 – 8.163	0.648
Adjusted Model			
Depression	- 25.24	-37.11 – -13.37	<0.001
Constant	62.63	59.00 – 66.26	<0.001

Table 12. Determinants of health -related quality of life according to SF-36 subscale Role Emotional in the Macassar residents 6 years after the fire (n=246): Univariate and multivariate linear regression models

Predictors for Role Emotional	Coefficient	95% C.I.	p-value
Unadjusted models			
Gender	-16.74	-29.67 – -3.81	0.011
Age	-0.78	-1.25 – -0.30	0.001
Smoking			
- Previous vs never	-6.05	-20.59– 8.48	0.413
- Current vs never	-6.09	-21.67 – 9.48	0.442
Current treatment for asthma	-4.01	-20.07 – 12.05	0.62
Previous Pulmonary TB	-14.94	-34.12 – 4.23	0.126
Hypertension	-4.63	-19.01 – 9.73	0.526
Cardiac disease	-27.85	-50.86 - -4.84	0.018
Diabetes	-3.07	-24.84 – 18.69	0.781
Arthritis	0.67	-19.88 – 21.24	0.948
Depression	-25.70	-46.86 - -4.60	0.017
Anxiety	-13.96	-33.15 – 5.22	0.153
PLRS/asthma	-4.44	-17.98 – 9.09	0.519
Reactive Upper Airway Dysfunction Syndrome	-9.68	-28.11 – 8.75	0.302
Adjusted Model			
Age	-0.75	-1.22 - -0.28	0.002
Gender	-14.39	-27.09 - -1.70	0.026
Depression	-21.85	-42.45 - -1.25	0.038
Constant	98.89	74.58 – 123.20	0.038

Table 13. Determinants of health -related quality of life according to SF-36 subscale Mental Health in the Macassar residents 6 years after the fire (n=246) : Univariate and multivariate linear regression models

Predictors for Mental Health	Coefficient	95% C.I.	p-value
Unadjusted models			
Gender	-11.74	-18.30 - -5.18	< 0.001
Age	-0.09	-0.34 – 0.15	0.464
Smoking			
- Previous vs never	-4.68	-12.06 – 2.68	0.212
- Current vs never	-10.05	-17.95 - -2.14	0.013
Current treatment for asthma	-2.35	-10.59 – 5.88	0.574
Previous Pulmonary TB	-2.15	-12.03 – 7.72	0.667
Hypertension	-4.83	-12.19 – 2.52	0.197
Cardiac disease	-1.52	-13.45 – 10.41	0.802
Diabetes	4.49	-6.66 – 15.64	0.429
Arthritis	-4.15	-14.69 – 6.37	0.438
Depression	-26.68	-37.10 - -16.26	<0.001
Anxiety	-24.83	-34.20 - -15.45	<0.001
PLRS/asthma	-0.18	-7.13 – 6.76	0.958
Reactive Upper Airway Dysfunction Syndrome	6.08	-3.35 – 15.53	0.206
Adjusted Model			
Depression	-19.64	-29.82 – -9.26	<0.001
Anxiety	-17.32	-26.76 - -7.88	< 0.001
Gender	-9.57	-15.77 - -3.37	0.003
Smoking	-4.84	-8.49 - -1.19	0.010
Current vs never	-9.80	-17.05 - -2.54	0.008
Previous vs never	-6.82	-13.61- -0.04	0.048
Constant	77.42	71.08 – 83.77	<0.001

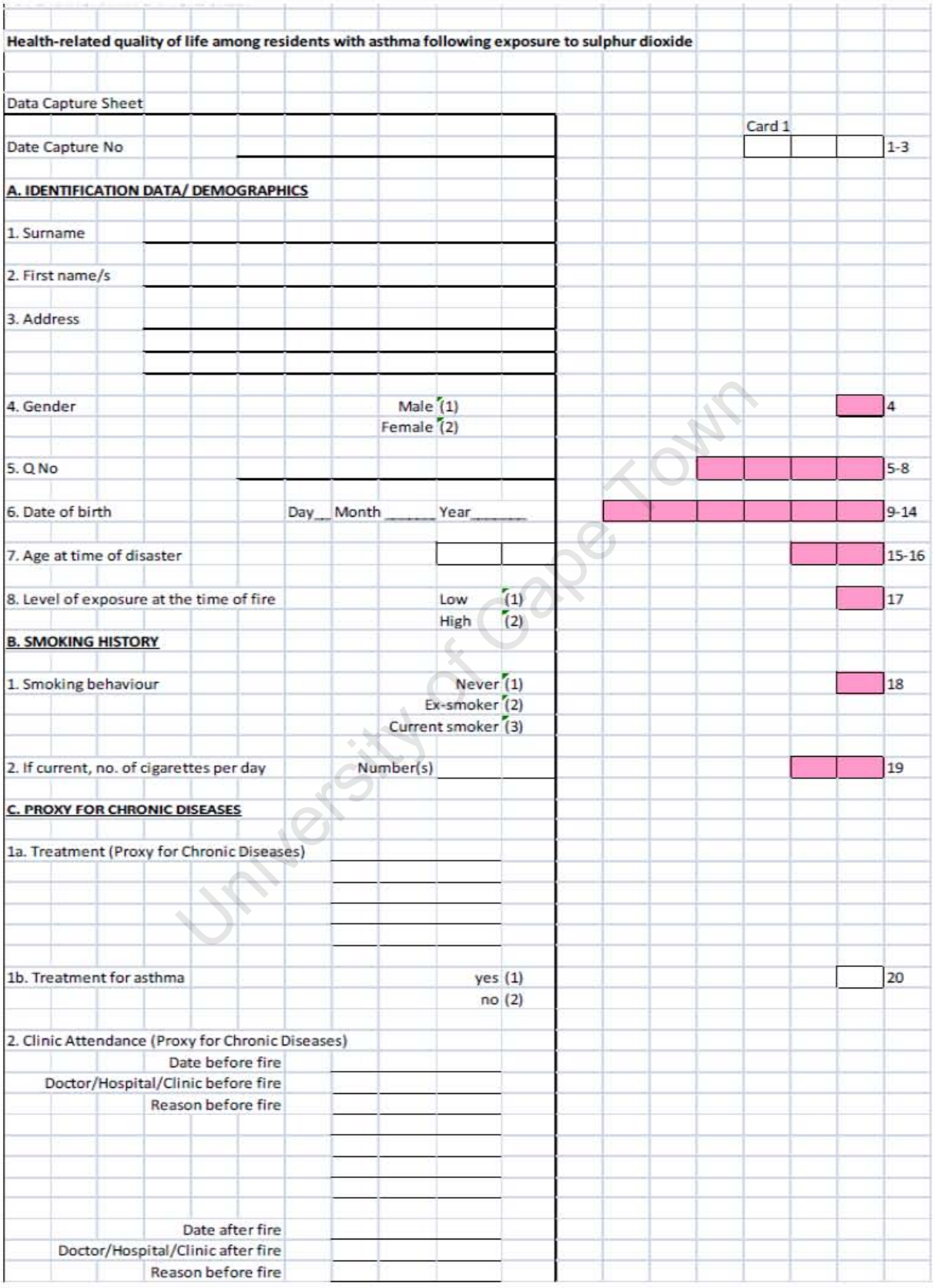
Table 14. Determinants of decline in health-related quality of life according to SF-36 subscales of Macassar residents at year 1 and year 6 after fire (n=246) in multivariate logistic regression models

	Decline in SF – 36 scores after 1 year ODDS RATIO (CI)			Decline in SF – 36 scores after 6 years ODDS RATIO (CI)		
	ROLE PHYSICAL	BODILY PAIN	GENERAL HEALTH	ROLE PHYSICAL	BODILY PAIN	GENERAL HEALTH
Treatment for asthma	1.54 (0.77 – 3.05)	0.86 (0.43 – 1.72)	5.14 (1.76 – 15.05)**	1.19 (0.60 – 2.35)	0.95 (0.49 – 1.85)	3.65 (1.07 – 12.46)*
Hypertension	0.50 (0.22 – 1.12)	0.86 (0.42 – 1.75)	0.50 (0.24- 1.04)	0.97 (0.49 – 1.90)	0.97 (0.50 – 1.87)	0.49 (0.21 – 1.13)
Diabetes	2.64 (1.00 – 6.95)*	3.77 (1.39 – 10.17)**	4.66 (1.01 – 21.36)*	1.14 (0.43 – 2.97)	2.49 (0.90 – 6.86)	1.56 (0.41 – 5.81)
Anxiety	0.75 (0.27 – 2.13)	3.07 (1.21 – 7.79)*	1.08 (0.39 – 2.96)	1.25 (0.52 – 3.02)	2.87 (1.12 – 7.32)*	1.14 (0.35 – 3.68)
Arthritis	0.65 (0.27 – 1.57)	2.05 (0.94 – 4.44)	0.76 (0.34 – 1.71)	0.66 (0.27 - 1.58)	1.73 (0.71 – 4.22)	0.25 (0.09 – 0.64)**
PLRS/asthma	1.97(1.09– 3.55)*	1.24 (0.70 – 2.21)	7.07 (2.88 – 17.35)***	1.57 (0.88 – 2.82)	1.05 (0.59 – 1.84)	3.50 (1.39 – 8.79)**
RUDS	1.82 (0.84– 4.15)	0.95 (0.42 – 2.13)	7.04 (1.61– 30.7) **	1.65 (0.74 – 3.79)	0.84 (0.38 – 1.84)	8.58 (1.10 – 65.02)*

Each odds ratio is a separate model adjusted for age, gender, smoking, pulmonary TB, depression and Cardiac disease. *: p<0.05; **: p<0.01; ***: p<0.001

RUDS – Reactive Upper Airways Dysfunction Syndrome.

Appendix 6: Data Capture Sheet



Health-related quality of life among residents with asthma following exposure to sulphur dioxide

Data Capture Sheet

Card 1

Date Capture No _____ 1-3

A. IDENTIFICATION DATA/ DEMOGRAPHICS

1. Surname _____

2. First name/s _____

3. Address _____

4. Gender Male (1) Female (2) 4

5. Q No _____ 5-8

6. Date of birth Day__ Month _____ Year_____ 9-14

7. Age at time of disaster 15-16

8. Level of exposure at the time of fire Low (1) High (2) 17

B. SMOKING HISTORY

1. Smoking behaviour Never (1) Ex-smoker (2) Current smoker (3) 18

2. If current, no. of cigarettes per day Number(s) _____ 19

C. PROXY FOR CHRONIC DISEASES

1a. Treatment (Proxy for Chronic Diseases) _____

1b. Treatment for asthma yes (1) no (2) 20

2. Clinic Attendance (Proxy for Chronic Diseases)

Date before fire _____

Doctor/Hospital/Clinic before fire _____

Reason before fire _____

Date after fire _____

Doctor/Hospital/Clinic after fire _____

Reason before fire _____

3. NEURO-PSYCH SYMPTOMS

3a. Can't concentrate		YES	NO	
	Before fire	(1)	(2)	21
	1 year	(1)	(2)	22
	6 years	(1)	(2)	23
3b. Difficulty remembering things		YES	NO	
	Before fire	(1)	(2)	24
	1 year	(1)	(2)	25
	6 years	(1)	(2)	26
3c. Feeling sad & depressed		YES	NO	
	Before fire	(1)	(2)	27
	1 year	(1)	(2)	28
	6 years	(1)	(2)	29
3d. Anxious		YES	NO	
	Before fire	(1)	(2)	30
	1 year	(1)	(2)	31
	6 years	(1)	(2)	32
3e. Having "nerves" troubles		YES	NO	
	Before fire	(1)	(2)	33
	1 year	(1)	(2)	34
	6 years	(1)	(2)	35
3f. Other symptoms		YES	NO	
	Before fire	(1)	(2)	36
	1 year	(1)	(2)	37
	6 years	(1)	(2)	38
	Specify _____			

4. CHRONIC DISEASES

4a. Chronic disease prior to fire

	YES	NO	
Asthma	(1)	(2)	39
Bronchitis	(1)	(2)	40
TB	(1)	(2)	41
Hypertension	(1)	(2)	42
Diabetic	(1)	(2)	43
Depression	(1)	(2)	44
anxiety	(1)	(2)	45
Cardiac Hx	(1)	(2)	46
Muscularskel	(1)	(2)	47

4b. Chronic diseases at 1 year

	YES	NO	
Asthma	(1)	(2)	48
Bronchitis	(1)	(2)	49
TB	(1)	(2)	50
Hypertension	(1)	(2)	51
Diabetic	(1)	(2)	52
depression	(1)	(2)	53
anxiety	(1)	(2)	54

Cardiac Hx	(1)	(2)		55
Muscularskel	(1)	(2)		56
4c. Chronic diseases at 6 years				
	YES	NO		
Asthma	(1)	(2)		57
Bronchitis	(1)	(2)		58
TB	(1)	(2)		59
Hypertension	(1)	(2)		60
Diabetic	(1)	(2)		61
Depression	(1)	(2)		62
anxiety	(1)	(2)		63
Cardiac Hx	(1)	(2)		64
Muscularskel	(1)	(2)		65
D. BASED ON FINAL DIAGNOSIS BY SPECIALIST				
1. RADS	yes	(1)		66
	No	(2)		
2. Asthma aggravation	Yes	(1)		67
	No	(2)		
3. COPD	Yes	(1)		68
	No	(2)		
4. Pulm TB	Yes	(1)		69
	No	(2)		
5. Rhinitis aggravation	Yes	(1)		70
	No	(2)		
6. RUDS	Yes	(1)		71
	No	(2)		
7. Sinusitis	Yes	(1)		72
	No	(2)		
E. SUBJECT STATUS				
	Asthma	(1)		73
	No Asthma	(2)		
F. HEALTH-RELATED QUALITY OF LIFE ASSESSMENT (SF-36E)				
1. GENERAL HEALTH (GH) Part 1				
	Excellent	(1)		74
	Very good	(2)		
	Good	(3)		
	Fair	(4)		
	Poor	(5)		
2. SELF - EVALUATION HEALTH TRANSITION				
	Much better	(1)		75
	Somewhat better	(2)		
	Same	(3)		
	Somewhat worse	(4)		
	Much worse	(5)		
3. ROLE - PHYSICAL (RP)				
	YES	NO		
3a. Time reduced Before fire	(1)	(2)		76

	1 year			(1)	(2)		77
	6 years			(1)	(2)		78
				YES	NO		
3b. Accomplished less		Before fire		(1)	(2)		79
		1 year		(1)	(2)		80
		6 years		(1)	(2)		81
				YES	NO		
3c. Limited in work or other activities		Before fire		(1)	(2)		82
		1 year		(1)	(2)		83
		6 years		(1)	(2)		84
				YES	NO		
3d. Difficulty work and other activities		Before fire		(1)	(2)		85
		1 year		(1)	(2)		86
		6 years		(1)	(2)		87
4. ROLE - EMOTIONAL (RE)							
				YES	NO		
4a. Time reduced		Before fire		(1)	(2)		88
		1 year		(1)	(2)		89
		6 years		(1)	(2)		90
				YES	NO		
4b. Accomplished less		Before fire		(1)	(2)		91
		1 year		(1)	(2)		92
		6 years		(1)	(2)		93
				YES	NO		
4c. Limited in work or other activities		Before fire		(1)	(2)		94
		1 year		(1)	(2)		95
		6 years		(1)	(2)		96
				YES	NO		97
4d. Difficulty work and other activities		Before fire		(1)	(2)		98
		1 year		(1)	(2)		99
		6 years		(1)	(2)		
5. BODILY PAIN (BP) and SOCIAL FUNCTIONING (SF)							
		Not at all	Slightly	Moderately	Quite a Bit	Extremely	
5a. Phys/emotional health	Before fire	(1)	(2)	(3)	(4)	(5)	100
[(SF) social -extent]	1 year	(1)	(2)	(3)	(4)	(5)	101
	6 years	(1)	(2)	(3)	(4)	(5)	102
		Not at all	Slightly	Moderately	Quite a Bit	Extremely	
5b. Bodily pain	Before fire	(1)	(2)	(3)	(4)	(5)	103
(BP)	1 year	(1)	(2)	(3)	(4)	(5)	104
	6 years	(1)	(2)	(3)	(4)	(5)	105
		Not at all	Slightly	Moderately	Quite a Bit	Extremely	
5c. Bodily pain interference	Before fire	(1)	(2)	(3)	(4)	(5)	106
(BP)	1 year	(1)	(2)	(3)	(4)	(5)	107
	6 years	(1)	(2)	(3)	(4)	(5)	108

6. SOCIAL FUNCTIONING (SF), VITALITY (V) and MENTAL HEALTH (MH).

		All time	Most time	Good bit of time	Some time	Little time	No time		
6a. Level of Pep	Before fire	(1)	(2)	(3)	(4)	(5)	(6)		109
(V)	1 year	(1)	(2)	(3)	(4)	(5)	(6)		110
	6 years	(1)	(2)	(3)	(4)	(5)	(6)		111
		All time	Most time	Good bit of time	Some time	Little time	No time		
6b. Level Nervous	Before fire	(1)	(2)	(3)	(4)	(5)	(6)		112
(MH)	1 year	(1)	(2)	(3)	(4)	(5)	(6)		113
	6 years	(1)	(2)	(3)	(4)	(5)	(6)		114
		All time	Most time	Good bit of time	Some time	Little time	No time		
6c. Level of Mood	Before fire	(1)	(2)	(3)	(4)	(5)	(6)		115
(MH)	1 year	(1)	(2)	(3)	(4)	(5)	(6)		116
	6 years	(1)	(2)	(3)	(4)	(5)	(6)		117
		All time	Most time	Good bit of time	Some time	Little time	No time		
6d. Level calm/peace	Before fire	(1)	(2)	(3)	(4)	(5)	(6)		118
(MH)	1 year	(1)	(2)	(3)	(4)	(5)	(6)		119
	6 years	(1)	(2)	(3)	(4)	(5)	(6)		120
		All time	Most time	Good bit of time	Some time	Little time	No time		
6e. Lot of Energy	Before fire	(1)	(2)	(3)	(4)	(5)	(6)		121
(V)	1 year	(1)	(2)	(3)	(4)	(5)	(6)		122
	6 years	(1)	(2)	(3)	(4)	(5)	(6)		123
		All time	Most time	Good bit of time	Some time	Little time	No time		
6f. Level down/blue	Before fire	(1)	(2)	(3)	(4)	(5)	(6)		124
(MH)	1 year	(1)	(2)	(3)	(4)	(5)	(6)		125
	6 years	(1)	(2)	(3)	(4)	(5)	(6)		126
		All time	Most time	Good bit of time	Some time	Little time	No time		
6g. Level worn-out	Before fire	(1)	(2)	(3)	(4)	(5)	(6)		127
(V)	1 year	(1)	(2)	(3)	(4)	(5)	(6)		128
	6 years	(1)	(2)	(3)	(4)	(5)	(6)		129
		All time	Most time	Good bit of time	Some time	Little time	No time		
6h. Level happiness	Before fire	(1)	(2)	(3)	(4)	(5)	(6)		130
(MH)	1 year	(1)	(2)	(3)	(4)	(5)	(6)		131
	6 years	(1)	(2)	(3)	(4)	(5)	(6)		132

		All time	Most time	Good bit of time	Some time	Little time	No time		
6i. Tiredness	Before fire	(1)	(2)	(3)	(4)	(5)	(6)		133
(V)	1 year	(1)	(2)	(3)	(4)	(5)	(6)		134
	6 years	(1)	(2)	(3)	(4)	(5)	(6)		135

		All time	Most time	Good bit of time	Some time	Little time	No time		
6j. Social activity	Before fire	(1)	(2)	(3)	(4)	(5)	(6)		136
(SF)	1 year	(1)	(2)	(3)	(4)	(5)	(6)		137
	6 years	(1)	(2)	(3)	(4)	(5)	(6)		138

7. GENERAL HEALTH (GH), Part 2

		Def True	Most True	Don't Know	Most False	Def False		
7a. Sicker than other people	Before fire	(1)	(2)	(3)	(4)	(5)		139
	1 year	(1)	(2)	(3)	(4)	(5)		140
	6 years	(1)	(2)	(3)	(4)	(5)		141

		Def True	Most True	Don't Know	Most False	Def False		
7b. Healthy as anybody								
	Before fire	(1)	(2)	(3)	(4)	(5)		142
	1 year	(1)	(2)	(3)	(4)	(5)		143
	6 years	(1)	(2)	(3)	(4)	(5)		144

		Def True	Most True	Don't Know	Most False	Def False		
7c. Expect health worse								
	Before fire	(1)	(2)	(3)	(4)	(5)		145
	1 year	(1)	(2)	(3)	(4)	(5)		146
	6 years	(1)	(2)	(3)	(4)	(5)		147

		Def True	Most True	Don't Know	Most False	Def False		
7d. Health excellent								
	Before fire	(1)	(2)	(3)	(4)	(5)		148
	1 year	(1)	(2)	(3)	(4)	(5)		149
	6 years	(1)	(2)	(3)	(4)	(5)		150

8. PHYSICAL FUNCTIONING (PF)

	Yes, limited a lot	Yes, limited a little	No, not limited at all		
8a. Vigorous activities	(1)	(2)	(3)		151

	Yes, limited a lot	Yes, limited a little	No, not limited at all		
8b. Moderate activities	(1)	(2)	(3)		152

	Yes, limited a lot	Yes, limited a little	No, not limited at all		
8c. Lift or carry groceries	(1)	(2)	(3)		153

8d. Climbing several flights of stairs	Yes, limited a lot	Yes, limited a little	No, not limited at all		154
	(1)	(2)	(3)		
8e. Climbing 1 flight of stairs	Yes, limited a lot	Yes, limited a little	No, not limited at all		155
	(1)	(2)	(3)		
8f. Bending, kneeling, or stooping	Yes, limited a lot	Yes, limited a little	No, not limited at all		156
	(1)	(2)	(3)		
8g. Walking more than a km	Yes, limited a lot	Yes, limited a little	No, not limited at all		157
	(1)	(2)	(3)		
8h. Walking several blocks	Yes, limited a lot	Yes, limited a little	No, not limited at all		158
	(1)	(2)	(3)		
8i. Walking one block	Yes, limited a lot	Yes, limited a little	No, not limited at all		159
	(1)	(2)	(3)		
8j. Bathing or dressing yourself	Yes, limited a lot	Yes, limited a little	No, not limited at all		160
	(1)	(2)	(3)		

Appendix 7: Ethics Approval Letter

UNIVERSITY OF CAPE TOWN

Health Sciences Faculty
Research Ethics Committee
Room E52-24 Groote Schuur Hospital Old Main Building
Observatory 7925
Telephone [021] 406 6626 • **Facsimile** [021] 406 6411
e-mail: shuretta.thomas@uct.ac.za

03 December 2009

REC REF: 474/2009

Prof M Jeebhay
Public Health & Family Medicine

Dear Prof Jeebhay

PROJECT TITLE: HEALTH RELATED QUALITY OF LIFE AMONGST RESIDENTS WITH PERSISTENT LOWER RESPIRATORY SYMPTOMS AND/OR ASTHMA, FOLLOWING SULPHUR DIOXIDE EXPOSURE.

Thank you for submitting your study to the Research Ethics Committee.

It is a pleasure to inform you that the Ethics Committee has **formally approved** the above-mentioned study.

Approval is granted for one year till the 10th December 2010.

Whilst the study presents no ethical issues as such since the project is essentially a reanalysis of an existing data set, we suggest that the proposal is rewritten and that the validity of the existing set be interrogated further.

We attach the reviewer's comments below regarding the methodological concerns:

The proposal is rather strangely presented as it seems as if the information sheet, informed consent and data collection questionnaire that are presented are not going to be used in the present study but were utilised in the 2001 study by Baatjies. There is a mixture of future and past tense and it is confusing as to what data will be collected and what has already been collected. It is suggested that the proposal be amended to clarify that the 'subjects' are not in fact the people who experienced the exposure but in fact, a data set already collected. The 'interview' described took place about 8 years ago and is not part of this study. The procedure should clarify how these existing records are to be utilised and not confuse the reader with a description of the previous study (this could go into the Literature Review).

There is another concern in that the original data set included results from the SF 36 which were based on the subject's recall of their health state prior to the incident, 1 year later (1996?) and 6 years later (2001). As HRQoL is meant to be assessed as experienced by the respondent on the day of the interview, the validity of this recalled data is highly questionable and the objectives and data analysis which rely on this information

should be excluded. Only the 6 year data, which was presumably referenced to the participants' health state on the day of interview, should be utilised.

It is also not clear from the proposal if the SF36 (or only the demographic questionnaire) was translated into Afrikaans through a rigorous translation process.

Please submit an annual progress report if the research continues beyond the expiry date. Please submit a brief summary of findings if you complete the study within the approval period so that we can close our file.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please quote the REC. REF in all your correspondence.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, HSF HUMAN ETHICS
Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938
This serves to confirm that the University of Cape Town Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Convention on Harmonisation Good Clinical Practice (ICH GCP) and Declaration of Helsinki guidelines.

The Research Ethics Committee granting this approval is in compliance with the ICH Harmonised Tripartite Guidelines E6: Note for Guidance on Good Clinical Practice (CPMP/ICH/135/95) and FDA Code Federal Regulation Part 50, 56 and 312.

S Thomas

Appendix 8: Quality Of Life Research Journal - Instructions For Authors.

Quality of Life Research

Article types

Quality of Life Research welcomes scientific articles in the following categories:
• Full-Length Original Articles (must include a structured abstract, maximum word limit of 4,000 words exclusive of abstract, tables, figures, and references)
• Brief Communications (maximum word limit of 1,500 words, exclusive of abstract, tables, figures, and references). See section below on Brief Communications.
Brief Communications
Brief communications are a maximum of 1,500 words, exclusive of abstract, figures, tables and references. Any topic can be submitted as a brief communication, but all manuscripts that report cross-cultural adaptations of existing measures will only be considered for publication as brief communications in Quality of Life Research. If a paper of this type provides substantially new methodological and/or substantive knowledge (e.g., a superior method of cross cultural adaptation, more thorough evaluation of the original instrument being adapted, multi language or multi country comparisons, etc.), authors should include a letter with their submission justifying the need for a full length report.

Language

We appreciate any efforts that you make to ensure that the language is corrected before submission. This will greatly improve the legibility of your paper if English is not your first language.

Ethical standards

Manuscripts submitted for publication must contain a statement to the effect that all human studies have been approved by the appropriate ethics committee (including the approval number) and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki. It should also be stated clearly in the text that all persons gave their informed consent prior to their inclusion in the study. Details that might disclose the identity of the subjects under study should be omitted.
The editors reserve the right to reject manuscripts that do not comply with the above-mentioned requirements. The author will be held responsible for false statements or failure to satisfy the above-mentioned requirements.

Manuscript submission

Legal requirements
Submission of a manuscript implies: that the work described has not been published before; that it is not under consideration for publication anywhere else; that its publication has been approved by all co-authors, if any, as well as by the responsible authorities – tacitly or explicitly – at the institute where the work has been carried out. The publisher will not be held legally responsible should there be any claims for compensation.

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How to submit
Authors should submit their manuscripts online. Electronic submission substantially reduces the editorial processing and reviewing times and shortens overall publication times. Please connect directly to the site and upload all of your manuscript files following the instructions given on the screen.

- Submit online

Manuscript preparation

Title page
The title page should include:
- A concise and informative title
- The name(s) of the author(s)
- The affiliation(s) and address(es) of the author(s)
- The e-mail address, telephone and fax numbers of the corresponding author
- The number of words in the manuscript excluding the abstract, tables, figures, and references.

Abstract
Please provide a structured abstract of no more than 200 words which should be divided into the following sections:
- Purpose (stating the main purposes and research question)
- Methods
- Results
- Conclusions

Keywords
Please provide 4 to 6 keywords which can be used for indexing purposes. Use terms from the Medical Subject Headings list from Index Medicus.
Abbreviations
Abbreviations and their explanations should be collected in a list.
Text
Text formatting
For submission in Word
• Use a normal, plain font (e.g., 12-point Times Roman) for text.
• Use italics for emphasis.
• Use the automatic page and line numbering functions.
• Do not use field functions.
• Use tab stops or other commands for indents, not the space bar.
• Use the table function, not spreadsheets, to make tables.
• Use the equation editor or MathType for equations.

Note: If you use Word 2007, do not create the equations with the default equation editor but use MathType instead.
• Save your file in either of the two formats doc and rtf. Do not submit docx files.

- Word template

Heading levels

Please use no more than three levels of displayed headings.
SI units
Please always use internationally accepted signs and symbols for units, SI units.
Terminology
Generic names of drugs are preferred; if trade names are used, the generic name should be given at first mention.
Equations
Please use the standard mathematical notation for formulae, symbols etc.:
• Italic for single letters that denote mathematical constants, variables, and unknown quantities
• Roman/upright for numerals, operators, and punctuation, and commonly defined functions or abbreviations, e.g., cos, det, e or exp, lim, log, max, min, sin, tan, d (for derivative)
• Bold for vectors, tensors, and matrices.

Footnotes
Do not use footnotes (except for acknowledgement footnote on the title page).
Acknowledgments
Acknowledgments of people, grants, funds, etc. can be placed in a separate section before the reference list. The names of funding organizations should be written in full.

References
The list of References should only include works that are cited in the text and that have been published or accepted for publication. Personal communications and unpublished works should only be mentioned in the text. Do not use footnotes or endnotes as a substitute for a reference list.

Citation in text
Citations in the text should be identified by numbers in square brackets. The numbers should be given in the order of appearance of the citations in the text. Some examples:
• Health-related quality of life research spans many disciplines [3].
• This result was later contradicted by Becker and Seligman [9].
• This effect has been widely studied [1-3, 7].

List style
Reference list entries should be numbered consecutively in the order cited
Journal article
1. Harris, M., Karper, E., Stacks, G., Hoffman, D., DeNiro, R., Cruz, P., et al. (2001). Writing labs and the Hollywood connection. Journal of Film Writing, 44(3), 213–245.
Article by DOI
2. Slifka, M.K., Whitton, J.L. (2000) Clinical implications of dysregulated cytokine production. Journal of Molecular Medicine, doi:10.1007/s001090000086
Book

3. Calfee, R. C., & Valencia, R. R. (1991). APA guide to preparing manuscripts for journal publication. Washington, DC: American Psychological Association.
Book chapter
4. O'Neil, J. M., & Egan, J. (1992). Men's and women's gender role journeys: Metaphor for healing, transition, and transformation. In B. R. Wainrib (Ed.), Gender issues across the life cycle (pp. 107–123). New York: Springer.
Online document
5. Abou-Allaban, Y., Dell, M. L., Greenberg, W., Lomax, J., Peteet, J., Torres, M., Cowell, V. (2006). Religious/spiritual commitments and psychiatric practice. Resource document. American Psychiatric Association. http://www.psych.org/edu/other_res/lib_archives/archives/200604.pdf. Accessed 25 June 2007.

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• Tables should always be cited in text in consecutive numerical order.
• For each table, please supply a table heading. The table title should explain clearly and concisely the components of the table.
• Identify any previously published material by giving the original source in the form of a reference at the end of the table heading.
Footnotes to tables should be indicated by superscript lower-case letters (or asterisks for significance values and other statistical data) and included beneath the table body.
Figures
• All figures are to be numbered using Arabic numerals.
• Figure parts should be denoted by lowercase letters.
• Figures should always be cited in text in consecutive numerical order.
• For each figure, please supply a figure caption.
• Make sure to identify all elements found in the figure in the caption.
• Identify any previously published material by giving the original source in the form of a reference at the end of the caption.
For more information about preparing your illustrations, please follow the hyperlink to the artwork instructions

- Artwork illustrations

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ESM may consist of
• information that cannot be printed: animations, video clips, sound recordings
• information that is more convenient in electronic form: sequences, spectral data, etc.
• large original data, e.g. additional tables, illustrations, etc.
• If supplying any ESM, the text must make specific mention of the material as a citation, similar to that of figures and tables (e.g., ". . . as shown in Animation 3.").
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