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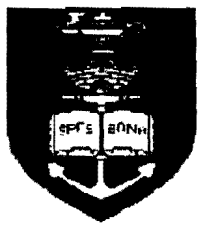

Predictors of obstructive lung disease among seafood processing workers along the West Coast of the Western Cape of South Africa

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A research report submitted to the Faculty of Health Sciences, University of Cape Town, in partial fulfilment of the degree of Masters of Medicine in the field of Occupational Medicine

March 2007

Cape Town, South Africa

DECLARATION

Predictors of obstructive lung disease among seafood processing workers along the West Coast of the Western Cape of South Africa.

I Shahieda Adams, hereby submit my research report for the degree of Masters in Medicine. 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 part of it has been, is being, or is to be submitted for another degree to any other university.

Signed by candidate

Shahieda Adams **30 March 2007**

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ABSTRACT

Introduction: This study examined the patterns and the prevalence of obstructive lung disease (asthma and COPD) and associated risk factors (age, gender, atopy, smoking history, allergic history, previous history of lung disease, occupational exposures, seafood intake) in a working population of seafood processing workers along the West coast of the Western Cape of South Africa. **Materials and method:** A cross-sectional study was conducted on 643 currently employed workers in two fish processing plants working in fish canning and fishmeal processing. A modified version of the European Community Respiratory Health Survey (ECRHS) questionnaire was used. Skin prick tests (SPT) used extracts of common airborne allergen. Lung function spirometry and methacholine challenge tests (tidal breathing method) were conducted using Vitallograph S-model bellows volume-time spirometers according to ATS guidelines. Serum omega-3 and omega-6 fatty acid levels were also analysed to examine the association between dietary fatty acids and asthma outcomes. Multivariate regression models were developed for asthma outcomes after adjusting for age, gender, sex and atopic status whilst the models were adjusted for age, gender and smoking history for COPD outcomes. **Results:** The overall prevalence of asthma symptoms (asthma attack / dyspnoea causing sleep disturbance/ tight chest causing sleep disturbance in the past 12 months) was 11%. The prevalence of non-specific bronchial hyperresponsiveness (PC 20 < 8 mg/ml or >12% increase in FEV_1 post bronchodilator) was 26% whilst the prevalence of current asthma diagnosis, defined as recent wheeze and the presence of non-specific

bronchial hyperresponsiveness was 6%. Atopy (defined as a positive SPT one or more common aeroallergens) was present in 37% of the population. The prevalence of COPD symptoms (reporting a chronic productive cough for 3 months in 2 consecutive years) was 3% whilst those with obstructive impairment on spirometry (FEV_1/FVC <70%) comprised 5% of the population. Overall 3% had evidence of both obstructive impairment and a post-bronchodilator FEV_1<80% predicted which provided a better reflection of the true prevalence of COPD. Multivariate logistic regression revealed that a history of chronic bronchitis (OR range, 2.45 – 23.82), chest infections in childhood (OR range, 3.04 – 21.08) and the presence of work-related wheeze or tight chest (OR range, 2.01 – 6.80) were significantly associated with all asthma outcomes. Experiencing peak exposures to vapours and dust at work were associated with current asthma (OR, 3.70; 95% CI, 1.72 – 7.93) and doctor-diagnosed asthma (OR, 2.56; 95% CI, 1.31 – 5.02). In the bivariate analysis, atopy on its own, or specific sensitisation to HDM or one of the indoor allergens (cat, dog, cockroach, house dust mite) was also significantly associated with all asthma outcomes. Omega- 6 (n-6) series fatty acid levels of Linolenic acid (18:2), Dihomo gamma linoleic acid (20:3) (OR, 1.84; 95%CI, 1.38 – 2.47) and total n-6 (OR, 1.14; 95%CI, 1.08 – 1.21) were positively associated with NSBH in multivariate regression models. In the omega-3 series, Eicosapentoic acid (20:5) (OR, 0.66; 95%CI, 0.54 – 0.80) and docosapentaenoic acid (22:5) (OR, 0.37; 95% CI, 0.20 – 0.69) were found to be negatively associated with NSBH. Consistent predictors of COPD outcomes were a history of previous TB treatment (OR range, 2.98 – 4.47), and a history of treatment for recurrent chest infections in childhood (OR

range, 5.53 – 19.65), whilst occupational characteristics (OR range, 4.22 – 11.34) were associated with symptoms of chronic bronchitis only.

Conclusion: This study demonstrated a strong link between pre-existing respiratory diseases, such as pulmonary TB and childhood chest infections, and obstructive lung disease manifesting as either asthma or COPD. Workplace exposures, in particular peak exposures to dust and vapours, as well as sensitization to indoor inhalant allergens are added risk factors, while high serum levels of omega-3 polyunsaturated fatty acids (derived from seafood in the diet) appear to be protective for adult asthma.

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1.1 INTRODUCTION

Obstructive lung disease manifests predominantly as either asthma or chronic obstructive pulmonary disease (COPD). Asthma is considered a chronic inflammatory disorder of the airways that causes recurrent episodes of coughing, wheezing, chest tightness and dyspnoea with limitation of airflow which is usually reversible. Inflammation makes the airways sensitive to stimuli such as allergens, chemical irritants, tobacco smoke, cold air or exercise. [1] It has recently been recognized that asthma is probably not a single disease but represents multiple, separate syndromes that overlap. In adult asthma different phenotypes exist which may be classified on the basis of clinical or physiological characteristics, trigger factors or inflammatory phenotype and there may be considerable overlap between these phenotypes (see figure 1).[2]

COPD is a chronic disease characterized by airflow limitation which is progressive, not fully reversible and is associated with an abnormal inflammatory response of the lungs to noxious particles or gases.[1] Whilst efforts have been made to standardize the diagnosis of COPD with the development of the Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines, the reliance on spirometry means that very few developing countries are able to implement these guidelines.[3] It is generally agreed though that COPD is under-diagnosed in developing countries and is likely to rise dramatically over the next two decades in tandem with an increase in the prevalence of smoking.[4]

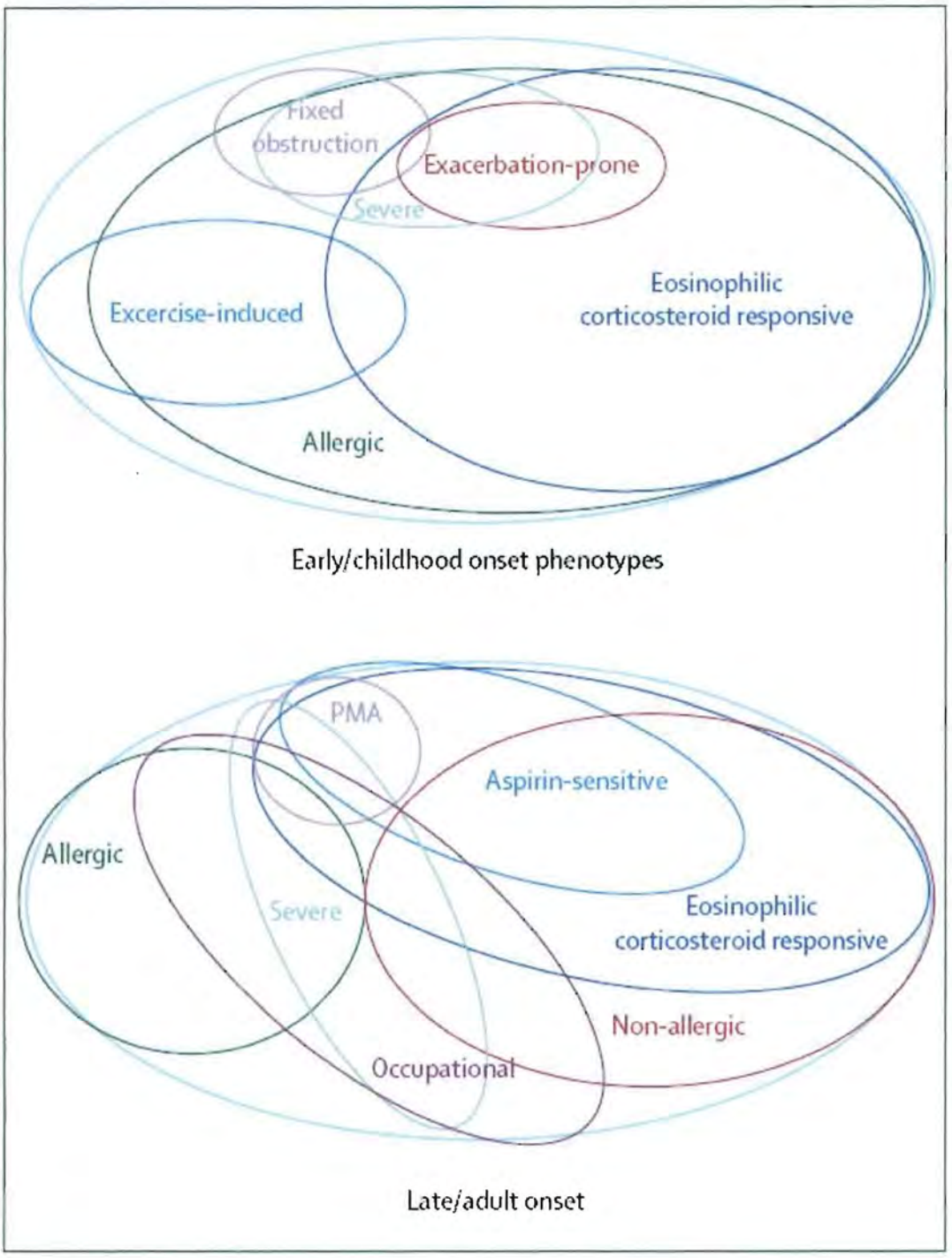

Figure 1 Diagram depicting different and overlapping asthma phenotypes in adults and children

Source: Wenzel SE. Asthma: defining of the persistent adult phenotypes. The Lancet August 2006; 368: 804-813

Despite the public health burden imposed by obstructive lung disease few studies in developing countries have focussed on the prevalence or incidence of this disease and the risk factors contributing to such a disease in the general population.[5,6,7] Epidemiological studies of obstructive lung disease and associated risk factors have also been vulnerable to bias due to the lack of standardized definitions for COPD and asthma, a reliance on self-reported symptoms defining outcomes and the multifactorial nature of these diseases.[1] There is a need therefore to use validated and explicit definitions when measuring the prevalence of obstructive lung disease that is supported by objective measures such as spirometry and tests of airway hyperresponsiveness. The use of tests of non-specific bronchial hyperresponsiveness (NSBH) and spirometry to support and lend credence to prevalence estimates has been limited due to cost and a lack of expertise particularly in developing countries.

1.2 LITERATURE REVIEW

1.2.1 PREVALENCE AND DETERMINANTS OF ASTHMA

It is estimated that globally 300 million people of all ages and ethnic backgrounds currently have asthma and that asthma accounts for 1 in every 250 deaths worldwide.[8] In sub-Saharan Africa asthma prevalence appears to be growing and the increase in part is related to the rapid rate of urbanization. Asthma appears to be uncommon in rural areas and it is postulated that asthma and allergy may be associated with the adoption of an urbanized "western" lifestyle.[9] Limited research has been done on the determinants of asthma in adult populations of the developing world although large multi-centric studies such as the International study on asthma and allergy in childhood (ISAAC) study have focussed on asthma among the children of developing countries. A population-based Turkish study focussing on asthma prevalence (yes to having been treated for asthma in the past year and/or ever having an asthma attack) in adults (N=1000) found the prevalence of asthma, allergic rhinitis and atopy to be 9.4%, 27.7% and 31.1% respectively.[10] A recent large and nationally representative survey of adults (20-44 years) in South Africa revealed the prevalence of asthma diagnosis (ever having been diagnosed with asthma by a doctor or a nurse) to be 2.7% in men and 3.1% in women whilst the prevalence of recent wheeze was reported by 11.7% of men and 14.5% of women, suggesting that asthma is a significant public health problem in SA. As with COPD, occupational exposures and a past history of TB were consistent predictors of both wheezing and an asthma diagnosis.[5] The population attributable fraction

(PAF) of occupational exposure was 12.2% for recent wheeze and 13.6% for asthma diagnosis whilst the PAF for TB was 5.4% for recent wheeze and 2.7% for asthma diagnosis. However, a limitation of the study was a reliance on self-reported symptoms to define asthma outcomes resulting in an inability to distinguish between subjects with COPD and asthma.

Bronchial hyperresponsiveness to non-specific stimuli such as cold air and exercise is one of the cardinal features of asthma.[11] A recent South African study investigating risk factors for non-specific bronchial hyperresponsiveness (NSBH) in persons aged 15-44 found that self-reported wheezing, a diagnosis of asthma, use of asthma medication and nasal allergy were significantly associated with NSBH. Other significant cofactors that displayed positive associations with NSBH were female sex [Odds ratio (OR), 3.6; 95% Confidence Interval (CI), 1.8-7], ever having worked in a job causing wheezing/chest tightness (OR, 6; 95% CI, 2.5-14.5) and a positive skin prick test (SPT) for *Aspergillus* mould (OR, 2.5; 95% CI, 1-6) and Timothy grass pollen (OR, 2.2; 95% CI, 1.1-4.5).[12]

1.2.2 PREVALENCE AND DETERMINANTS OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE

The estimates of global all-age incidence of COPD are 9/1000 males and 7.3/1000 in females and it is projected to become the third leading cause of death in the world by 2020.[13,15] The increasing prevalence of COPD is attributed mainly to the increased use of tobacco products worldwide and up to 50% of smokers over the age of 65 are affected.[14,15] There is a paucity of

data on the determinants of COPD for sub-Saharan Africa with most studies focussing on the prevalence of chronic bronchitis. Most of these studies tend to be conducted among men in occupational settings in whom smoking is common.[9] A review of several large population-based studies suggests that occupational exposures may account for a large proportion of either symptoms (median 15%; range 4-29%) or functional impairment consistent with COPD (median 19%; range 12-55%).[1] Other factors implicated in the aetiology of COPD are air pollution, low socio economic status and endogenous risk factors such as male gender, genetic factors, presence of respiratory disease in childhood and family history.[13]

A large multi-centric Indian study focussing on the epidemiology of COPD found the prevalence of COPD (presence of cough and expectoration on most days for at least three months in the year for two consecutive years or more) to be 4.1% with a male: female ratio of 1.6:1 and a smoker to non-smoker ratio of 2.7:1. Risk factors for COPD were found to be male sex, age, low socio-economic status and urban residence.[16] Similarly, in a large population based survey in South Korea that utilized spirometry to assess COPD prevalence (GOLD stage 1: FEV1/FVC<70%), reported a prevalence of COPD of 7, 8% in all adults over the age of 18 years (men, 10.9%; women, 4.9%) and 17.2% in adults over the age of 45 years (men, 25.8%; women, 9.6%).[17] Independent risk factors for COPD included age older than 65 years (OR, 4.05; 95%CI 2.92-5.61), male sex (OR, 2.62; 95%CI, 1.64-4.18), more than 20 pack-years of smoking (OR, 2.81; 95%CI, 1.76-4.50), and low income (OR, 2.13; 95%CI 1.52- 2.98).

The true prevalence of COPD in sub-Saharan Africa is unknown, however the risk factors which appear to be important for COPD are tobacco smoking, air pollution and respiratory infections, whilst in South Africa recognized factors contributing to the prevalence of COPD are tuberculosis, industrial and mining dust exposures and the domestic use of biomass fuels.[15] In a nationally representative South African survey Ehrlich *et al* determined the prevalence of chronic bronchitis (cough with phlegm every day for at least 3 months a year for at least 2 consecutive years) to be 2.3% in adult males and 2.8% in women. Risk factors other than smoking that were found to be predictive of chronic bronchitis was a history of tuberculosis in men and women (men, OR, 4.9; 95% CI; 2.6-9.2; women OR, 6.6; 95%CI, 3.7-11.9) occupational exposure in men (OR, 1.6; 95%CI, 1.0 – 2.6) and smoky domestic fuel in women (OR, 1.5; 95%CI, 1.0 -2.1). The population attributable fraction (PAF) was 25% for current smoking, 14% for occupational exposure and 10% for a past history of TB in men. Limitations of this study were in part due to the nature of the study design being that of a demographic and household survey that relied on self-reported symptoms of chronic bronchitis without more objective tests of lung function (spirometry and NSBH). There was also under representation of working people in the study sample.[7]

1.2.3 SMOKING AND OBSTRUCTIVE LUNG DISEASE

The relationship between smoking and obstructive lung disease is a complex one. The "Dutch hypothesis" developed half a century ago, attempted to link atopy, asthma, smoking and COPD.[19] The theory proposed that COPD developed in smokers from exaggerated airway damage in patients with an

underlying atopic diathesis. Further evidence in this regard is the presence of eosinophilic inflammation in the airways of those diagnosed with COPD. A possible explanation is the presence of an atopic diathesis or pre-existing asthma in such individuals. Other researchers have associated the presence of eosinophilia with the presence of concurrent asthma in those with COPD. Notwithstanding the complexity of the relationship between smoking and obstructive lung disease, an association between smoking and bronchial irritation, the precipitation of acute episodes, NSBH and increased sensitization to some occupational allergens have been demonstrated in adults with asthma.[18] Whilst many large population studies have confirmed an association between NSBH and smoking, it is unclear whether this represents a causal association. Explanations for the association have centred on the propensity of smoking to unmask NSBH or aggravate pre-existing NSBH.[19] An epidemiological study on the genetics and environment of asthma (EGEA) has shown an association between smoking and severity of asthma but no clear relationship between smoking habits and asthma causation.[20]

1.2.4 AEROALLERGENS, ATOPY AND OBSTRUCTIVE LUNG DISEASE

Whilst atopy is recognized as a strong predictor of asthma, the presence of allergen-specific IgE does not necessarily translate into clinical allergy as in asthma.[21] Questions remain around the predictive value of sensitization as it pertains to number of allergens (monosensitization versus polysensitization) and type of aeroallergen sensitized to (indoor, pollen or mould). A recent review from the Global Allergy and Asthma European Network (GA^2 LEN)

suggests that a family history of atopy and polysensitization are more likely to be associated with symptoms of allergic disease and that mono- and polysensitized patients may differ in respect of their immune response.[21]
A population-based Finnish study found the prevalence of atopy (positive to a least one aeroallergen on SPT) to be 46.9 % and demonstrated an inverse relationship between atopy and age among adults 26-60 year of age. [22]
Polysensitization (sensitization to at least four aeroallergens) was more common in the younger age group (42%) than in the older (> 50 years) group (16%)($p<0.001$). Furthermore sensitization to multiple allergens was associated with a high prevalence of asthma, allergic rhinitis or conjunctivitis and wheeze. A large US-based population study reported an even higher prevalence rate for atopy (54.3%) in those aged 6-59 years with the prevalence to at least one indoor allergen being slightly higher than that to one outdoor allergen (43% versus 40%). Sensitization occurred most commonly to house dust mite, ragweed, perennial rye grass pollen and German cockroach.[23]

Little is known about the patterns of allergen sensitization and the relationship between atopy and asthma in sub-Saharan African adults.[9] Sensitization to indoor allergens such as house dust mite and cockroach, inner-city residence, low position in sib-ship were found to be independent risk factors for asthma in Ghanaian children whilst a recent East African study in adult women revealed no relationship between atopy and asthma. In Africa the presence of parasitic diseases may be a confounding factor and some studies suggest that a high degree of parasite infection may prevent asthma from developing

in atopic individuals.[9] The increase in allergic diseases in the industrialized world has often been explained by a decline in infections during childhood causing a skewed Th2 response as expounded by the " hygiene hypothesis (Figure 2).[24]

Figure 2 Diagram depicting the relationship between infectious environment during childhood and the alteration of Th1 and Th2 reponses to innocuous antigen

Source: Romagni SJ. Allergy Clin Immunol 2000;105:399-408

Studies looking at the relationship between atopy and COPD have tended to focus on lung function decline as an indicator of COPD and have been complicated by the difficulty in distinguishing clearly between subjects with asthma and COPD. Skin test reactivity to common aeroallergens has been shown to be a significant predictor of the annual rates of decline in FEV_1 and FEV_1/FVC in an occupational cohort (N=1025) even after adjusting for the effects of smoking.[25] This suggests that atopy may be related to accelerated

decline in lung function, independent of the effects of cigarette smoke in those with COPD.

1.2.5 DIETARY POLYUNSATURATED FATTY ACIDS (PUFAs), INFLAMMATION AND OBSTRUCTIVE LUNG DISEASE

1.2.5.1 The role of PUFAs in inflammatory disease

Patterns of the consumption of the long chain n-3 and n-6 fatty acids have been demonstrated to be associated with the development of airway inflammation (Figure 3). The most abundant n-6 PUFA in the western diet, linoleic acid (18:2n-6), is converted to arachidonic acid, a precursor of both prostaglandin E_2 and leukotriene B_4, both of which have proinflammatory biologic actions. In contrast, alpha linolenic acid (18:3n-3) an n-3 PUFA is converted to eicosapentaenoic acid (20:5n-3), which can inhibit arachidonic acid and thereby suppress production of the n-6 eicosanoid inflammatory mediators.[26] In the typical Western diet 25-fold more omega n-6 PUFAs than n-3 PUFAs are consumed.[27] It is suggested on this basis that changes in dietary patterns in developed countries could partly explain the increase in the prevalence of asthma. The omega n-3 PUFAs are found in high quantities in fish oil and monounsaturated oils such as canola and flaxseed oils, whereas n-6 PUFA are present in polyunsaturated fats such as soybean, corn, safflower and sunflower oils.[26]

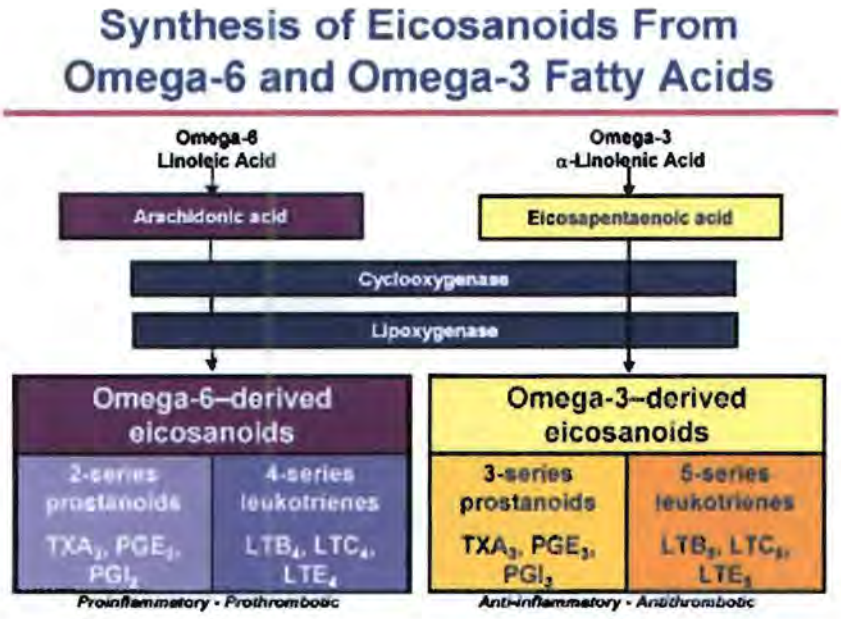

Figure 3 Diagram depicting the synthesis of eicosanoids from omega-6 and omega-3 fatty acids

Source: Din JN, Newby DE, Flapan AD. Omega-3 fatty acids and cardiovascular disease-fishing for a natural treatment. BMJ 2004;328:30-35

1.2.5.2 Correlation between serum fatty aid and dietary intake

In examining the relationship between fatty acids and respiratory outcomes, most studies have reported on the frequency of dietary intake of fish / seafood as reported by study subjects.[28] A strong correlation between habitual fish intake and serum eicosapentaenoic acid (EPA) and docosapentaenoic acid (DPA) levels has been shown suggesting that serum concentrations of n-3 fatty acids are useful as biomarkers for dietary fish intake.[29,30] Plasma n-3 concentrations have been found to be significantly higher in women than in men, 20% higher in fish-oil consumers versus non-fish-oil consumers and twice as high in fatty fish consumers compared to total fish consumers.[30]

1.2.5.3 PUFAs and respiratory health

Studies examining respiratory health effects related to dietary intake of fatty acids have produced inconclusive results. Fish intake viewed as an indicator of n-3 PUFA intake has been associated with beneficial effect on lung function, but the relationship with clinically evident asthma or COPD is less impressive.[28] Other studies have demonstrated that a diet high in marine n-3 PUFA (fish oil) may have beneficial effects on airway hyperresponsiveness and that fish oil supplementation may reduce the severity of exercise-induced bronchoconstriction in adults.[27] While most studies have relied on self-reporting of dietary intake to estimate n-3 PUFA intake, a recent study looking at serum fatty acid levels and asthma outcomes in young adults have demonstrated a consistent association between the 20:3n-6 PUFA Dihomo gamma-linoleic acid (DHGLA) and 20:2 n-6 PUFA and asthma outcomes. Higher DHGLA levels were also found in those who reported suffering a recent asthma attack.[31] In a prospective study of adult-onset asthma, high margarine intake and high intake of oleic acid (18:1 n-9) has also been shown to be positively associated with asthma symptoms.[32]

The relationship between COPD and dietary fat intake has demonstrated inconsistent results and has been very vulnerable to confounding factors. A significant beneficial association has been demonstrated between fish intake and the prevalence of COPD among former and current smokers.[28] These results raise interesting questions around the role of dietary fats in obstructive lung disease and warrant further research.

1.2.6 OCCUPATION AND OBSTRUCTIVE LUNG DISEASE

Work-related factors are responsible for up to one third of all asthma cases (Attributable fraction, 29%; 95% CI, 25-33%).[33] The important role of occupation as a risk factor for the development of obstructive lung disease has therefore been recognized globally and the median population attributable fraction for asthma and chronic obstructive pulmonary disease is estimated to be 15%.[1,33,34,35] In a large South African population survey the population attributable fraction of asthma due to occupational factors was estimated to be 13% whilst a recent review of occupational asthma (OA) reported the incidence of OA in SA to be 1.7/100 000.[6] Work-related asthma comprises asthma caused by specific agents in the workplace (OA) as well as pre-existing asthma aggravated by workplace exposures. Occupational exposures contribute to asthma through specific exposures to sensitizing agents or respiratory irritants in the workplace.[1,6] Over 250 agents have been identified and documented to cause sensitizer-induced occupational asthma whilst the mechanisms underlying irritant-induced asthma are less well understood.[1] In al large population-based study, the National Health and Nutrition Examination Survey (NHANES), Arif et al demonstrated a more than 2-fold increase in work–related asthma (yes to "has a doctor ever told you that you had asthma" and "are any of the symptoms: wheezing, whistling, stuffy, itchy or runny nose , watery, itchy eyes brought on by work environment") in the agriculture, forestry and fishing industry (OR 2.94, 95% CI, 0.95-9.15). Furthermore a significantly increased risk in the prevalence of work-related wheeze (working or whistling in your chest in past 12 months in those with

work-related symptoms) was also observed in this industrial group of workers (OR 2.67, 95CI 1.44 -4.97), suggesting that workers in the fishing industry among others are at increased risk of developing asthma.[34] A review of occupational asthma in the seafood industry indicated a prevalence of 6-36%.[36] Jeebhay et al has reported an occupational asthma prevalence of 3% in seafood processing workers in the Western Cape province of South Africa.[37] This is based on analysis of the current data set which forms the basis for this current study.

In summary given that known risk factors such as smoking, atopy and NSBH only account for a proportion of cases of obstructive lung disease, and the growing body of evidence mainly in industrialized countries implicating occupational factors in the aetiology of both asthma and COPD, further research is needed to assess the extent to which these associations also pertain to developing countries in general and to South Africa in particular.[1,6]

1.3 AIM

To determine the patterns of and the factors associated with obstructive lung disease in a population of seafood processing workers on the West Coast of the Western Cape Province of South Africa.

1.4 OBJECTIVES

- To describe the demographic profile of seafood processing workers living in a fishing village along the West Coast of the Western Cape Province

- To describe the prevalence of the major patterns of obstructive lung disease (asthma and chronic obstructive pulmonary disease) in this population

- To describe the factors associated with obstructive lung disease (asthma and COPD) with specific reference to host (age, gender, allergic history, smoking history and previous history of lung disease) and environmental (occupational exposures)

- To estimate the population attributable fraction of selected risk factors in relation to the burden of obstructive lung disease (asthma and COPD) in this population

- To conduct a detailed analysis of allergic sensitization profiles to common allergens (using skin prick tests) in the study population and their relationship with asthma outcomes

- To conduct a detailed analysis of seafood intake and serum fatty acid profiles of the study population and their relationship with asthma outcomes

CHAPTER TWO: METHODOLOGY

2.1 STUDY DESIGN, POPULATION AND SAMPLING

This study data set was obtained from a cross-sectional study which was originally designed to specifically determine the prevalence and risk factors for occupational asthma due to fish allergens among seafood processing workers.[37] This current study has focussed more broadly on the environmental and host predictors of obstructive lung disease among working adults of a fishing village along the West coast of South Africa. The study population comprised 643 currently employed workers of two fish-processing plants in St. Helena Bay. In one plant all 260 workers were included in the study and, for efficiency reasons, a stratified random sample was drawn from the other plant which constituted 383 workers from a total workforce of 1275.

2.2 HEALTH OUTCOME MEASUREMENTS

2.2.1 Questionnaire

Each worker answered a standard questionnaire specifically designed for the investigation of respiratory health according to the protocol for the European Community Respiratory Health Survey. [38] It addressed acute and chronic work-related respiratory symptoms and a history of previous medical illnesses. Modifications were also made to include questions on seafood aerosol exposure, tobacco smoke exposure and patterns of seafood ingestion. Occupational exposure indices were developed from self-reported exposures obtained from the questionnaire. A more detailed exposure-response evaluation based on objective exposure characterization is the subject of

another study.[37] The questionnaire was adapted for local conditions and translated into Afrikaans and Xhosa and back translated to assess validity and reproducibility. It was administered by trained interviewers in the respondent's language of choice.

2.2.2 Skin prick test (SPT)

Skin prick tests (SPT) were performed on each worker using a battery of standard common local aeroallergens that included house dust mite (*Dermatophagoides Pteronyssinus*), bermuda grass (*Cynodon dactylon*), rye grass (*Lolium perenne*), cockroach (*Blatella germanica*), cat (*Felis domesticus*), dog (*Canis familiaris*), mouldmix (*Cladosporium herbarum, Alternaria alternata, Fusarium*) and Aspergillus (*Aspergillus fumigatus*). Histamine dihydrochloride was used as a positive control and a diluent of glycerol/sodium chloride as a negative control. Atopic status was defined as a positive SPT to any one of the common aeroallergens.[39] A positive result was considered as a SPT of ≥ 3mm in comparison to the negative control.

2.2.3 Serum determination of omega-3 and omega-6 fatty acids

All workers had blood samples taken for analysis of n-3, n-9 and n-6 fatty acid content as % weight of phospholipids. Analysis of the samples was carried out by the Nutritional Intervention Research Unit of the Medical Research Council. For serum determinations of omega fatty acids, plasma was thawed and extracted with chloroform/methanol. All the extraction solvents contained 0.01% butylated hydroxytoluene as an antioxidant. Heptadecanoic acid (C17:0) was used as an internal standard to quantify the individual fatty acids.

Neutral lipids were separated from total phospholipids by thin layer chromatography on pre-coated silica gel 60 plates without a fluorescent indicator using a solvent system. The lipid bands were visualized with longwave ultraviolet light after spraying the plates with chloroform/methanol. The total phospholipid and was scraped off and analyzed for fatty acid composition. The levels of individual fatty acids were measured and the results expressed as a percentage weight of total phospholipid.

2.2.4 Spirometry

American Thoracic Society (ATS) guidelines were followed when conducting spirometry.[40] Vitallograph S model bellows volume-time spirometers, calibrated at least twice daily, were used for performing spirometry. Technologists who had undergone training in standard technique conducted the spirometry. The technologists were blinded to the exposure status of each worker. Spirometry was performed in a sitting position without nose clips. Each worker performed up to eight trials to produce three acceptable curves. The lung function indices of primary interest included forced vital capacity (FVC) and forced expiratory volume in one second (FEV_1). The best FEV_1 and FVC were used regardless of whether they belonged to the same tracing. Lung volumes obtained by spirometry were adjusted for body temperature and pressure according to the temperature and atmospheric pressure measured on a continuous basis throughout the day. Heights of workers were recorded for calculating predicted lung function indices using reference values of the European Community for Coal and Steel (ECCS) with lower limits corresponding to the 95th percentile. Spirometry was not done if the following

contra-indications were present: subject was pregnant, epileptic, recent (3 months prior) stroke or heart attack, recent (3 weeks prior) respiratory tract infection or TB diagnosis.

2.2.5 Methacholine challenge test

Non-specific inhalation challenge testing was performed on all workers (except where contra-indicated) by trained technologists according to an abbreviated protocol used in epidemiological surveys. The two-minute tidal breathing method, with incremental concentrations of methacholine, as outlined by the recent American Thoracic Society guidelines adapted for local conditions was used. [41] In all subjects eligible for methacholine challenge test (MCT), saline diluent was first administered as a control to ensure that the FEV_1 did not increase by >10% from baseline. Inhalations were done every five minutes while the subject was seated and had a nose-clip. Subjects then underwent either a short, medium or full protocol depending on symptoms and degree of lung function impairment at baseline. If the initial FEV_1 was 70-80% of predicted or the subject had current symptoms of airway obstruction, concentrations commencing at 0.03mg/ml and doubling concentrations to 16mg/ml were used (long protocol). If subjects had a positive history of asthma or symptoms that were controlled and an initial $FEV_1 \geq 80\%$ of predicted, concentrations of 0.125mg/ml doubling to 16mg/ml were used (medium protocol). If subjects had no symptoms or history of asthma and initial $FEV_1 \geq 80\%$ of predicted, concentrations of 2, 4, 8 and 16mg/ml were used (short protocol). A positive methacholine challenge test with a $PC_{20} \leq 8$ mg/ml was considered to be highly suggestive of non-specific bronchial hyperresponsiveness.

Specific contraindications for MCT included breast feeding, elevated blood pressure (>180/110), subjects with either FEV_1 <1.5L or FEV_1 < 70% of the predicted mean value or a subject with acute asthma symptoms at the time of testing. In such cases a bronchodilator (400 µg salbutamol) was administered by metered dose inhaler (MDI) instead. A change in FEV_1 of ≥12 % after 10 minutes of bronchodilator administration was considered indicative of the presence of NSBH. All workers who underwent methacholine challenge were also given a bronchodilator and their lung function tested until the post-bronchodilator FEV_1 was >90% of the initial FEV_1. Other special precautionary measures included oxygen and B_2-adrenergic agents, which were readily available for nebulization.

2.3 DATA MANAGEMENT AND ANALYSIS

The main respiratory outcome of interest was the presence of obstructive lung disease focussing particularly on asthma and COPD outcomes. Explicit definitions were employed with asthma and COPD outcomes based on validated questions reporting symptoms, spirometry, and tests for NSBH and / or combinations of these.

2.3.1 Definitions for asthma-related outcomes

1. Atopy: A positive SPT with a wheal read 15 minutes after testing that had a diameter (mean of two perpendicular measures) of ≥ 3 mm more than the negative control to any allergen

2. Asthma symptoms: yes to any of: "Have you had an attack of asthma in the last 12 months?", "Have you been woken by an attack of shortness of breath in the last 12 months?", "Have you been woken up with a feeling of tightness in your chest any time in the last 12 months?"

3. Current asthma: Self-reported wheeze in the past 12 months and the presence of NSBH

4. Doctor-diagnosed asthma: yes to both questions: "Have you ever had asthma?" and "Was this confirmed by a doctor?"

5. Non-specific bronchial hyperresponsiveness: A positive methacholine challenge test with a $PC_{20} \leq 8$ mg/ml causing a drop in FEV_1 of 20% or more or an increase in FEV_1 of ≥ 12 % after 10 minutes of bronchodilator administration on baseline spirometry, was considered indicative of the presence of NSBH.

2.3.2 Definitions for COPD-related outcomes

1. Chronic bronchitis symptoms: Reporting a chronic productive cough for 3 months in 2 or more consecutive years

2. Airway obstruction: FEV1 / FVC < 70%

3. Fixed airway obstruction: FEV1 / FVC < 70% and absence of NSBH

4. COPD: FEV_1 / FVC < 70% and post-bronchodilator FEV1 < 80% predicted

2.3.3 Demographic, medical and occupational variables as predictors

Predictor variables pertained to sociodemographic factors, environmental and occupational exposures and past medical history.

- Sociodemographic variables included in the study were those of age, sex, atopy and employment status (permanent/seasonal/casual)
- Past medical history included a history of previous tuberculosis, chronic bronchitis, recurrent chest infections during childhood, history of allergic disease and treatment for such a disease
- Exposure variables included smoking, occupational exposures and consumption of seafood in the diet.

2.3.4 Analysis of data

The data was analysed using Stata, version 8. Data analysis focussed on the relationship between the independent variables and the diagnosis of obstructive lung disease (asthma and COPD) to ascertain which factors best predicted the presence of disease. Univariate analysis summarized the distribution of each measured variable. Bivariate analysis was employed to assess the nature of the associations between outcomes, exposures and covariates. Each coefficient estimate is represented from a separate bivariate model. Multiple logistic regression models were developed to assess the exposure effects on health outcomes. Confounding and effect modification by covariates were considered and adjusted for in the formulation of the models. Each coefficient estimate is represented from a separate multivariate model containing the variable of interest and confounding variables. The population attributable fraction in respect of selected variables was calculated for the

diagnosis of asthma and COPD in accordance with the following formula. Population attributable fraction: p (POR-1) / [p (POR -1) + 1 where POR = prevalence odds ratio as an estimate of the relative risk and p = prevalence of the risk factor in the population.

2.4 ETHICS

Ethical approval was obtained for the original study which focussed on the prevalence and determinants of occupational asthma due to seafood exposure. Since no new data was collected and anonymity was preserved during this study, the requirement for renewed ethics application in respect of this study was waived by the Post-graduate dissertation committee of the University of Cape Town.

CHAPTER THREE: RESULTS

3.1 DEMOGRAPHIC AND MEDICAL CHARACTERISTICS

The study population comprised 643 workers from two seafood processing factories. All were interviewed by questionnaire. 626 subjects underwent skinprick tests (SPT) and 582 underwent spirometry, whilst a further 542 were assessed for the presence of NSBH. The study subjects had a mean age of 35 years. The majority of workers were female (65%) (see Table 3.1). A high prevalence of smoking was found with 327 (51%) workers current smokers at the time of the survey. The population also reported a high prevalence of previous respiratory disease with 13% having been treated for tuberculosis in the past. Although a large proportion (23%) reported suffering from ocular nasal symptoms very few (2%) were receiving medical treatment for symptoms of allergic disease such as asthma or allergic rhinitis at the time of the survey

3.2. OCCUPATIONAL AND ENVIRONMENTAL EXPOSURE CHARACTERISTICS

Examination of the occupational characteristics revealed that the majority of workers (70%) were seasonal workers (see Table 3.2). There were 420 (65%) workers who reported having experienced some occupational exposure to steam, gases, dust or fumes with 38% describing such exposure as excessive whilst 19% reported experiencing adverse respiratory symptoms as a result of episodic peak occupational exposures. A high percentage of workers reported suffering either tight chest or wheeze (15%) or ocular-nasal symptoms (27%) due to occupational exposures.

Of those who had experienced an asthma attack in the preceding year 4% cited the precipitating factor to be an exposure to dust or sprays at work. Other environmental factors triggering asthma attacks were changes in the weather (6%), exercise (5%) and exposure to tobacco smoke (4%).

Table 3.1 Demographic characteristics of seafood processing workers along the West Coast of the Western Cape

Demographic characteristics	**Prevalence Mean / SD (N=643)**
Age (yrs)	
- Overall	34 ± 10.67
- Female	34 ± 9.66
- Male	35 ± 12.09
Gender (%)	
Female: male	65%:35%
Smoking no (%)	
- Current	327 (51%)
- Ex-smoker	73 (11%)
- Non-smoker	242 (38%)
Past medical history	
Previous treatment for tuberculosis	81 (13%)
Previous treatment for chronic bronchitis	61 (9%)
Previous treatment for recurrent chest infections in childhood	36 (6%)
History of allergic disease	
No. with ocular-nasal symptoms	149 (23%)
No. with hayfever in childhood	30 (5%)
No. on current asthma treatment	29 (5%)
No on current hayfever treatment	16 (2%)

Table 3.2 Occupational characteristics and environmental triggers of respiratory symptoms in seafood processing workers along the West Coast of the Western Cape

Occupational characteristics and exposures	Prevalence (N=643)
Current job status	
- Permanent	183 (29%)
- Seasonal	451 (70%)
- Casual	9 (1%)
Occupational exposure to steam, gasses, dust or fumes	420 (65%)
Extent of occupational exposure to dust, mist spray in current job	
-Excessive	246 (38%)
-Average	204 (32%)
-Little	29 (5%)
-Nil	164 (26%)
Episode of peak exposure causing wheezy chest or cough	124 (19%)
Work-related chest symptoms	97 (15%)
Work-related ocular-nasal symptoms	171 (27%)
Environmental triggers of recent asthma attack	
Changes in the weather	38 (6%)
Strenuous exercise	29 (5%)
Dust or sprays at work	26 (4%)
Tobacco smoke	25 (4%)
Breathing in cold air	23 (4%)
Grass or flowers	18 (3%)
Contact with animals	5 (1%)

Note: Continuous variables: mean ± SD; Categorical variables: number (%)

3.3 SEAFOOD INTAKE AND SERUM FATTY ACID PROFILES

Questions on dietary history that focussed on fish and seafood consumption revealed high levels of frequent (>once/month) fish (94%) and squid (58%) consumption among the study population (Table 3.3). Whilst many workers reported consuming rock lobster/prawns (73%) and oyster/mussels (64%) this did not occur with the same frequency of intake as for fish and squid.

Table 3.3 Recent seafood dietary intake (N=642) of seafood processing workers along the West Coast of the Western Cape

Type and frequency of seafood dietary intake In the past year	Frequency (%)	Frequency of consumption (%) (N=642)
Any seafood type		638 (99%)
Fish		638 (99%)
>1/month	605 (94%)	
<1/month	33 (5%)	
Never	4 (1%)	
Rock lobster / prawns		466 (73%)
>1/month	26 (4%)	
<1/month	440 (69%)	
Never	176 (27%)	
Squid (calamari)		387 (60%)
>1/month	13 (2%)	
<1/month	374 (58%)	
Never	255 (40%)	
Abalone (perlemoen)		183 (28%)
>1/month	2	
<1/month	181 (28%)	
Never	459 (72%)	
Oyster (mussels)		412 (64%)
>1/month	41 (6%)	
<1/month	371 (58%)	
Never	229 (36%)	

Laboratory analysis of serum fatty acids analyzed specifically for serum levels of polyunsaturated fats (PUFAs) of the omega 3 (n-3) and omega 6 (n-6) in 633 subjects (Table 3.4). Linolenic acid (LA), arachidonic acid (AA) and dihomogamma-linoleic acid (DHGLA) had the highest mean serum levels as a % weight of total phospholipids among the n-6 PUFAs. Docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) had the highest mean serum levels among the n-3 PUFAs. The mean ratio of total n-6 to n-3 was high (3.71).

Table 3.4 Serum fatty acid profile (N=633) as a percentage weight of total phospholipid among seafood processing workers along the West Coast of the Western Cape

Type of fatty acid	Mean serum fatty acid level µg / ml	Weight % phospholipid Mean (SD)
n-6 series polyunsaturated		
18:2 Linolenic acid (LA)	211.73	18.45 (3.78)
18:3 Gamma- linolenic acid (GLA)	0.76	0.64 (0.69)
20:2	4.42	0.39 (0.17)
20:3 Dihomo gamma-linoleic acid (DHGLA)	26.37	2.26 (0.74)
20:4 Arachidonic acid (AA)	90.83	7.89 (1.94)
22:2	7.06	0.63 (0.21)
22:4	2.80	0.25 (0.13)
n-3 series polyunsaturated		
18:3 Alpha-linolenic acid (ALA)	0.81	0.07 (0.05)
20:0	6.12	0.55 (0.17)
20:5 Eicosapentaeoic acid (EPA)	24.19	2.10 (1.40)
22.5 Docosapentaenoic acid (DPA)	12.85	1.11 (0.37)
22.6 Docosahexaenoic acid (DHA)	65.02	5.64 (1.61)
24:0	16.85	1.50 (0.39)
Total		
n-6	343.96	29.93 (4.92)
n-3	102.87	8.93 (2.86)
n-6:n-3 ratio	3.71	3.71 (1.37)

3.4 ALLERGIC SENSITIZATION ON SKIN PRICK TESTING

A substantial proportion of the population were atopic (37%) on skinprick testing with sensitization to indoor aeroallergens such as house dust mite (25%) and cockroach (15%) being the most prevalent (See Table 3.5). Most subjects were sensitized to three or less allergens (32%) and a similar number displayed sensitization to at least one of the indoor aeroallergens (HDM, cockroach, cat, dog). Sensitization to the mould group of allergens was low (5%).

Table 3.5 Allergic sensitization profiles of seafood processing workers along the West Coast of the Western Cape

Sensitization variables	**Prevalence (%) (N=626)**
All aeroallergens Atopy (Positive to at least one aeroallergen)	234 (37%)
Positive to one aeroallergen	
House dust mite	155 (25%)
Cockroach	94 (15%)
Rye grass	89 (14%)
Bermuda grass	57 (9%)
Dog	34 (5%)
Mouldmix	22 (4%)
Cat	20 (3%)
Aspergillus	14 (2%)
No with one to three aeroallergens positive	211 (32%)
No with greater than three aeroallergens positive	35 (6%)
At least one indoor allergen (HDM, cockroach, cat, dog) **positive**	200 (32%)
At least one pollen allergen (bermuda grass, rye grass)	98 (16%)
At least one mould allergen (mould mix, *Aspergillus*)	33 (5%)

3.5 PULMONARY FUNCTION AND NON-SPECIFIC CHALLENGE TESTS

Among the 582 workers who underwent spirometry, 543 proceeded to challenge tests (either methacholine or bronchodilator challenge) to assess for the presence of NSBH. Reasons for exclusion from NSBH testing were mainly related to pre-existing contraindications stipulated in the protocol (recent abdominal / chest surgery, epilepsy, pregnancy, current use of beta-blockers, elevated blood pressure and recent respiratory tract infection). A further 9 workers were unable to perform spirometry despite 8 attempts. Of those who proceeded with MCT 278 (61%) followed the short protocol, 108 (24%) the medium protocol and 68 (15%) the long protocol. The results of pulmonary function and non-specific bronchial challenge tests are presented in Table 3.6. Whilst 29% of workers had an initial FEV_1 < 80% of predicted values, only 5% had evidence of airway obstruction (FEV_1/FVC, 70%) and 12 % had a post-bronchodilator FEV_1 <80% of predicted. Males were more likely than females to demonstrate evidence of airway obstruction (OR, 4.09; 95% CI, 1.89 - 8.86). A total of 141 (26%) tested positive for NSBH whilst the test was discontinued in 23 subjects due to a decline in FEV_1 of >10% after administration of saline diluent. Females were more likely to display NSBH than males as evidenced by a positive methacholine challenge test (OR, 2.71; 95% CI, 1.73-4.25).

Table 3.6 Pulmonary function and non-specific bronchial challenge test outcomes among seafood processing workers along the West Coast of the Western Cape

Pulmonary function indices	Overall N=582	Male N=208	Female N=374	P-value
FEV_1 (litres)	2.76 (0.74)	3.31 (0.80)	2.45 (0.50)	<0.001*
FVC (litres)	3.28 (0.86)	4.04 (0.79)	2.84 (0.56)	<0.001*
FEV_1 % predicted	87 ± 14	87 ± 16	87 ± 14	0.859*
FVC % predicted	88 ± 13	89 ± 13	87 ± 13	0.264*
FEV_1 / FVC	84 ± 8	81 ± 10	86 ± 7	<0.001*
No. with FEV_1/FVC < 70% (absolute)	31 (5%)	21 (10%)	10 (3%)	<0.001**
No. with initial FEV_1 < 80% predicted	167 (29%)	54 (26%)	113 (30%)	0.277 **
No. with post-bronchodilator FEV_1 <80% predicted	68 (12%)	25 (12%)	43 (12%)	0.977 **
No. with evidence of bronchial hyperresponsiveness	**(N=543)**	**(N=200)**	**(N=343)**	
No. with ≥ 12% FEV_1 increase post bronchodilator (n_c =89)	12 (2%)	3 (2%)	9 (3%)	0.750***
No. with ≥ 10% FEV_1 decrease post saline diluent (n_c = 477)	23 (4%)	6 (3%)	17 (5%)	0.254**
No. with ≥ 20% FEV_1 decrease to methacholine at 8mg/ml (n_c = 454)	129 (24%)	27 (14%)	102 (30%)	<0.001**
-short protocol (n_c =278)	54 (10%)			
-medium protocol (n_c = 108)	41 (8%)	11 (6%)	43 (13%)	0.001**
-long protocol (n_c = 68)	34 (6%)	8 (4%)	33 (10%)	0.012**
		8 (4%)	26 (8%)	0.024**

Continuous variables-mean ± SD; Categorical variables-number (%); n_c: number completed test;
Reference values are from the European Community for Coal and Steel (ECCS), 1993.
*Two-sample t-test
** Chi-square test with 1 degree of freedom
*** Fisher's exact test

3.6 ENVIRONMENTAL AND HOST FACTORS ASSOCIATED WITH ASTHMA OUTCOMES

3.6.1 Host factors

The prevalence of four asthma-related outcomes was considered (Table 3.7). There were 11% with the presence of self-reported asthma symptoms (yes to any of: "Have you had an attack of asthma in the last 12 months?", "Have you been woken by an attack of shortness of breath in the last 12 months?", "Have you been woken up with a feeling of tightness in your chest any time in the last 12 months?"). Twenty six percent had NSBH (defined as a positive methacholine challenge test with a $PC_{20} \leq 8$ mg/ml causing a drop in FEV1 of 20% or more or an increase in FEV_1 of ≥12 % after 10 minutes of bronchodilator administration). There were 5% with current asthma (Self-reported wheeze in the past 12 months and NSBH) and 7% with doctor-diagnosed asthma (yes to both: "Have you ever had asthma?" and "Was this confirmed by a doctor?" The latter two diagnostic categories were considered to have greater specificity than the former two.

In the unadjusted logistic regression models, increasing age was significantly associated with asthma symptoms (OR, 1.03; 95%CI, 1.00-1.05) and current asthma (OR, 1.04; 95%CI, 1.01-1.07) whilst female gender was significantly associated with NSBH (OR, 2.17; 95%CI, 1.73-4.25) (Table 3.7). Atopy was strongly and positively associated with all asthma outcomes, the association being strongest for current asthma (OR, 3.42; 95% CI, 1.62-7.24).There was no significant association between smoking and any of the asthma outcomes.

Previous treatment for chronic bronchitis (OR, 5.82; 95% CI, 2.66 –12.73) or recurrent chest infections in childhood (OR, 8.91; 95% CI3.74 – 21.22) were strongly associated with current asthma and were generally significant predictors for all asthma outcomes. This was not the case for those who had reported having received treatment for tuberculosis in the past. As expected, a history of hay fever and being on asthma treatment were consistently associated with all asthma outcomes. In the multivariate analysis a history of having been previously treated for chronic bronchitis, recurrent chest infections in childhood or being on asthma treatment remained significantly associated with all asthma outcomes after adjusting for age, gender, atopy and smoking (Table 3.8). Pre-existing morbidity due to respiratory diseases such as chronic bronchitis and recurrent chest infections in childhood accounted for 29.9% and 42.5% respectively of the population attributable fraction for current asthma cases.

3.6.2 Occupational characteristics and exposures

Examination of the impact of occupational status revealed that seasonal workers were less likely to report suffering from asthma symptoms (OR, O.60; 95% CI, 28 – 0.95) but were more likely to test positive for NSBH (OR, 1.63; 95% CI, 1.04 – 2.56) (Table 3.7). A self-reported general history of occupational exposure to workplace agents and degree of exposure were not related to asthma outcomes. However, those who specifically reported episodes of peak exposure to workplace agents were more likely to have asthma symptoms, current asthma and doctor-diagnosed asthma. Suffering

from tight chest or wheeze in relation to peak exposures was strongly associated with current asthma (OR, 8.98 95% CI, 4.33 – 18.63). After adjusting for potential confounders in the multivariate models, the occupational factors that continued to show an association with general asthma outcomes were peak occupational exposures, work-related ocular-nasal symptoms and work-related chest symptoms (Table 3.8).

Table 3.7 Unadjusted logistic regression models for asthma outcomes in relation to demographic, medical and occupational characteristics among seafood processing workers along the West Coast of the Western Cape

Demographic , medical and occupational characteristics	ASTHMA OUTCOMES			
	Asthma symptoms	NSBH	Current Asthma	Doctor diagnosed asthma
Prevalence (%)	**72/643 (11%)**	**141/543 (26%)**	**33 / 543 (6%)**	**47/643 (7%)**
Age (yrs)	1.03 (1.00 – 1.05)*	1.01 (0.99 – 1.03)	1.04 (1.01 – 1.07)*	1.02 (0.99 – 1.05)
Female gender	0.85 (0.52 – 1.41)	2.71 (1.73 – 4.25)***	1.53 (0.70 – 3.36)	1.08 (0.58 – 2.02)
Atopy	2.05 (1.23 – 3.42)**	1.58 (1.07 – 2.34)*	3.42 (1.62 – 7.24)***	3.07 (1.61 – 5.82)***
Smoking				
- Non-smoker	1.00	1.00	1.00	1.00
- Ex-smoker	1.59 (0.76 – 3.33)	1.63 (0.86 – 3.09)	1.61(0.54 – 4.79)	1.25 (0.53 – 2.94)
- Current	0.89 (0.52 – 1.52)	1.32 (0.86 – 2.02)	1.15 (0.53 – 2.50)	0.54 (0.28 – 1.05)
Past medical history				
Previous treatment for tuberculosis	0.72 (0.32 – 1.64)	0.84 (0.46 – 1.53)	0.68 (0.20 – 2.29)	0.63 (0.22 – 1.80)
Previous treatment for chronic bronchitis	4.52 (2.45 – 8.32)***	2.71 (1.50 – 4.90)**	5.82 (2.66 – 12.73)***	22.31 (11.37 – 43.78)***
Previous treatment for recurrent chest infections in childhood	6.89 (3.37–14.11)***	2.66 (1.26 – 5.61)**	8.91 (3.74 – 21.22)***	17.21 (8.13 – 36.44)***
History of allergic disease				
Ocular-nasal symptoms	1.92 (1.14 – 3.24)*	1.61 (1.05 – 2.48)*	3.00 (1.47 – 6.12)**	3.57 (1.95 – 6.54)***
Hayfever in childhood	2.07 (0.82 – 5.25)	0.50 (0.17 – 1.49)	1.41 (0.32 – 6.21)	2.04 (0.68 – 6.11)
On current asthma treatment	24.02 (10.41 – 55.43)***	3.98 (1.70 – 9.30)**	12.73 (5.15 – 31.47)***	33.01 (14.28 – 76.28)***
On current hayfever treatment	2.74 (0.86 – 8.73)	1.04 (0.33 – 3.31)	4.47 (1.21–16.53)*	3.06 (0.84 – 11.13)

Asthma symptoms: yes to any of: "Have you had an attack of asthma in the last 12 months?", "Have you been woken by an attack of shortness of breath in the last 12 months?", "Have you been woken up with a feeling of tightness in your chest any time in the last 12 months?"
Current asthma: Self-reported wheeze in the past 12 months and NSBH on challenge testing
Doctor-diagnosed asthma: yes to both: "Have you ever had asthma?" and "Was this confirmed by a doctor? "
Non-specific bronchial hyperresponsiveness: A positive methacholine challenge test with a $PC_{20} \leq 8$ mg/ml causing a drop in FEV1 > 20% or an increase in FEV_1 of ≥12 % after 10 minutes of bronchodilator administration
*P ≤0.05; ** P ≤0.01; ***P≤ 0.001

Table 3.7 Unadjusted logistic regression models for asthma outcomes in relation to demographic, medical and occupational characteristics among seafood processing workers along the West Coast of the Western Cape (continued)

Occupational characteristics and exposures	ASTHMA OUTCOMES			
	Asthma symptoms	**NSBH**	**Current Asthma**	**Doctor diagnosed asthma**
Prevalence (%)	**72/643 (11%)**	**141/543 (26%)**	**33 / 543 (6%)**	**47/643 (7%)**
Current job status Seasonal vs. permanent work	0.60 (0.28 – 0.95)*	1.63 (1.04 – 2.56)*	0.95 (0.44 – 2.04)	0.52 (0.28 – 0.95)*
Occupational exposure to steam, gasses, dust or fumes	1.00 (0.60 – 1.67)	1.07 (0.71 – 1.61)	2.05 (0.87 – 4.79)	1.60 (0.81 – 3.15)
Excessive occupational exposure to dust, mist spray in current job	0.97 (0.54 – 1.73)	0.93 (0.36 -2.39)	1.08 (0.44 – 2.66)	1.26 (0.62 -2.54)
Episode of peak exposure causing wheezy chest or cough	2.01 (1.17 – 3.48)*	1.17 (0.73 – 1.88)	3.91 (1.91 – 8.01)***	3.16 (1.70 – 5.87)***
Work related asthma symptoms	7.21 (4.24 – 12.28)***	2.40 (1.47 – 3.92)***	8.98 (4.33 – 18.63)***	6.11 (3.28 – 11.39)***
Work-related ocular-nasal symptoms	3.03 (1.83 – 4.99)***	1.34 (0.88 – 2.04)	2.18 (1.07 – 4.46)*	1.63 (0.87 – 3.03)

Asthma symptoms: yes to any of: "Have you had an attack of asthma in the last 12 months?", "Have you been woken by an attack of shortness of breath in the last 12 months?", "Have you been woken up with a feeling of tightness in your chest any time in the last 12 months?"
Current asthma: Self-reported wheeze in the past 12 months and NSBH on challenge testing
Doctor-diagnosed asthma: yes to both : "Have you ever had asthma?" and "Was this confirmed by a doctor? "
Non-specific bronchial hyperresponsiveness: A positive methacholine challenge test with a $PC_{20} \leq 8$ mg/ml causing a drop in FEV1 > 20% or an increase in FEV_1 of ≥12 % after 10 minutes of bronchodilator administration
* P ≤0.05; ** P ≤0.01; ***P≤ 0.001

Table 3.8. Multivariate logistic regression for asthma outcomes in relation to medical and occupational variables among seafood processing workers along the West Coast of the Western Cape

Medical and occupational characteristics	ASTHMA OUTCOMES			
	Asthma symptoms	NSBH	Current Asthma	Doctor diagnosed asthma
Past medical history				
Previous treatment for tuberculosis	0.69 (0.28 – 1.67)	0.81 (0.44 – 1.50)	0.74 (0.22 – 2.55)	0.55 (0.16 – 1.84)
Previous treatment for chronic bronchitis	3.82 (1.96 – 7.45)***	2.45 (1.32 – 4.58)**	5.54 (2.42 – 12.67)***	23.82 (11.03 – 51.45)***
Previous treatment for recurrent chest infections in childhood	7.74 (3.50 – 17.12)***	3.04 (1.38 – 6.72)**	14.19 (5.32 – 37.83)***	21.08 (8.85 – 50.23)***
History of allergic disease				
Ocular-nasal symptoms	1.53 (0.86 – 2.72)	1.57 (0.99 – 2.49)	2.53 (1.18 – 5.43)*	2.42 (1.25 – 4.68) **
Hayfever in childhood	2.34 (0.87 – 6.27)	0.75 (0.24 – 2.33)	1.69 (0.34 – 8.39)	2.65 (0.82 – 8.58)
Current asthma treatment	18.94 (7.52 – 47.68)***	4.21 (1.58 – 11.19)**	12.24 (4.18 – 35.89)***	27.48 (10.13 – 74.53)***
Current hayfever treatment	1.43 (0.37 – 5.50)	0.53 (0.14 – 2.06)	1.83 (0.36 – 9.26)	1.25 (0.25 – 6.10)
Occupational characteristics and exposures				
Current job status				
Seasonal vs. permanent work	0.61 (0.30 – 1.24)	0.97 (0.54 – 1.76)	0.82 (0.28 – 2.35)	0.36 (0.16 – 0.83)
Occupational exposure to steam, gasses, dust or fumes	0.96 (0.55 – 1.67)	0.97 (0.63 – 1.49)	2.02 (0.83 – 4.90)	1.69 (0.82 – 3.49)
Excessive occupational exposure to dust, mist spray in current job	1.01 (0.54 – 1.25)	0.83 (0.49 – 1.39)	1.18 (0.45 – 3.07)	1.32 (0.62 – 2.84)
Episode of peak exposure causing wheezy chest or cough	1.57 (0.87 – 2.86)	1.17 (0.70 – 1.93)	3.70 (1.72 – 7.93)***	2.56 (1.31 – 5.02)**
Work related asthma symptoms	6.75 (3.78 – 12.06)***	2.01 (1.19 – 3.40)**	6.80 (3.14 – 14.75)***	5.00 (2.52 – 9.89)***
Work-related ocular-nasal symptoms	3.13 (1.83 – 5.35)***	1.30 (0.84 – 2.02)	2.09 (0.98 – 4.48)	1.44 (0.73 – 2.82)

Adjusted for age, gender, atopy and smoking
*P ≤0.05
** P ≤0.01
***P≤ 0.001

3.6.3 Allergic sensitization profiles

In the logistic regression models, being atopic or sensitized to house dust mite was strongly associated with all asthma outcomes (OR, 2.89; 95% CI, 1.40 – 5.93 for current asthma), whilst sensitization to cockroach was only associated with NSBH (OR, 1.89; 95%CI, 1.15 – 3.12) and current asthma (OR, 2.35; 95%CI, 1.05 – 5.25) (see Table 3.9). This was also reflected in the group allergen profile with sensitization to any one of the indoor allergens showing a consistent positive association with asthma. Sensitization to three or less allergens was associated with asthma symptoms, current asthma and doctor-diagnosed asthma whilst sensitization to more than three allergens was more likely to predict NSBH. While sensitization to the pollen and mould group of allergens was associated with doctor-diagnosed asthma and asthma symptoms respectively, they appeared to be less important a predictor of asthma in this population. Notably this was not the case for *Aspergillus* sensitization which was strongly associated with asthma symptoms (OR, 5.02; 95%CI,1.63 – 15.45) and with doctor-diagnosed asthma (OR, 3.90; 95%CI, 1.05 – 14.54).

Table 3.9 Unadjusted logistic regression models for skin reactivity profiles and asthma outcomes

Sensitization variables	Asthma outcomes			
	Asthma symptoms (N= 626)	**NSBH (N=537)**	**Current Asthma (N=626)**	**Doctor diagnosed asthma (N=626)**
All aeroallergens				
Atopy	2.05 (1.23 – 3.42)**	1.58 (1.07 – 2.34)*	3.42 (1.62 – 7.24)***	3.07 (1.61 – 5.82)**
Allergen score	1.19 (1.01– 1.40)*	1.17 (1.02 – 1.34)*	1.20 (0.96 – 1.49)	1.35 (1.14 – 1.61)**
Bermuda grass	1.68 (0.79 – 3.61)	1.11 (0.58 – 2.13)	1.01 (0.30 – 3.42)	2.95 (1.34 – 6.51)**
House dust mite	1.87 (1.09 – 3.21)*	1.66 (1.09 – 2.55)*	2.89 (1.40 – 5.93)**	3.20 (1.71 – 6.00)***
Cockroach	1.15 (0.58 – 2.29)	1.89 (1.15 – 3.12)*	2.35 (1.05 – 5.25)*	1.55 (0.72 – 3.35)
Ryegrass	0.95 (0.45 – 1.99)	1.04 (0.60 – 1.80)	0.85 (0.29 – 2.47)	1.66 (0.77 – 3.60)
Cat	2.19 (0.71 – 6.77)	1.19 (0.41– 3.43)	1.01 (0.13 – 7.81)	3.63 (1.16 – 11.40)*
Mouldmix	2.62 (0.93 – 7.35)	1.57 (0.5 7– 4.33)	0.86 (0.11 – 6.61)	1.37 (0.31 – 6.08)
Dog	1.90 (0.76 – 4.77)	2.21 (1.08 – 4.54)*	1.84 (0.53 – 6.36)	3.21 (1.25 – 8.25)*
Aspergillus	5.02 (1.63 – 15.45)**	2.31 (0.61 – 8.71)	1.41 (0.18 – 11.12)	3.90 (1.05 – 14.54)*
No with one to three aeroallergens positive	2.03 (1.21– 3.40)**	1.32 (0.87– 1.97)	3.84 (1.83 – 8.02)***	2.36 (1.27 – 4.41)**
No with greater than three aeroallergens positive	1.45 (0.54 – 3.87)	2.23 (1.03 – 4.84)*	0.52 (0.07 – 3.92)	2.43 (0.89 – 6.61)
At least one indoor allergen (cat, dog, cockroach, house dust mite)	1.91 (1.14 – 3.21) **	1.83 (1.22 – 2.73)*	3.36 (1.63 – 6.96)***	2.92 (1.56 – 5.47)**
At least one pollen allergen (bermuda grass, ryegrass)	1.37 (0.72 – 2.62)	1.16 (0.69 – 1.95)	1.53 (0.64 – 3.64)	2.24 (1.11 – 4.53)*
At least one mould allergen (mould mix , *Aspergillus)*	2.95 (1.27 – 6.84)*	1.75 (0.75 – 4.09)	0.55 (0.07 – 4.18)	2.61 (0.95 – 7.14)

Allergen score: Absolute count of number of aeroallergens that subject tested positive to on SPT (maximum score of 8).
*P ≤0.05
** P ≤0.01
***P≤ 0.001

3.6.4 Seafood intake and polyunsaturated fatty acid (PUFA) profiles

In the unadjusted and adjusted logistic regression models consumption of rock lobster/ prawns (OR, 0.52; 95%CI, 0.31- 0.86) and oyster (OR, 0.58; 95%CI, 0.36-0.96) appeared to be protective against the development of asthma symptoms, whilst consumption of other types of seafood did not impact on asthma outcomes (Table 3.10). Among the n-6 PUFAs, 18:2 / LA (OR, 1.14; 95% CI, 1.08 – 1.21) and 20:3/ DHGLA (OR, 1.67; 95% CI, 1.27 – 2.20) were positively associated with NSBH. The n-6 PUFA 22:2 had a protective association with respect to asthma outcomes that was significant for NSBH (OR, 0.29; 95%CI, 0.10-0.87). However, none of the fatty acids showed any association with atopy. After adjusting for age, gender and smoking the n-6 PUFA'S LA, DHGLA, and AA were all positively associated with the presence of NSBH (Table 3.11). In addition AA also showed a positive association with doctor-diagnosed asthma. The n-9 PUFA 18:1, n-6 PUFA 22:2 and n-3 PUFAs EPA and DPA demonstrated a protective effect on NSBH after adjusting for age, gender and smoking.

Table 3.10 Unadjusted logistic regression models for seafood intake and serum phospholipid (% weight) in relation to asthma outcomes

Type of fatty acid	ASTHMA OUTCOMES				
	Asthma symptoms	NSBH	Current Asthma	Doctor diagnosed asthma	Atopy
Seafood consumption					
Fish	-	-	-	1.41 (0.15 – 13.64)	0.57 (0.08 – 4.26)
Rock lobster / prawns	0.52 (0.31 – 0.86)**	0.88 (0.46 – 1.69)	0.72 (0.34 – 1.52)	0.73 (0.51 – 1.06)	1.05 (0.73 – 1.51)
Squid (calamari)	0.75 (0.46 – 1.23)	1.18 (0.63 – 2.18)	0.88 (0.44 – 1.80)	0.98 (0.70 – 1.38)	1.16 (0.83 – 1.62)
Abalone (perlemoen)	1.12 (0.66 – 1.91)	0.75 (0.37 – 1.51)	1.07 (0.50 – 2.30)	1.13 (0.79 – 1.63)	1.08 (0.75 – 1.54)
Oyster (mussel)	0.58 (0.36 – 0.96)*	0.98 (0.53 – 1.82)	0.50 (0.25 – 1.00)	0.88 (0.62 – 1.24)	1.22 (0.86 – 1.71)
n-9					
n-9 18.1	0.97 (0.83 – 1.13)	0.93 (0.83 – 1.04)	0.93 (0.75 – 1.14)	0.87 (0.76 – 1.00)	1.04 (0.94 – 1.15)
n-6 series polyunsaturated					
18:2 Linolenic acid (LA)	0.99 (0.93 – 1.06)	1.14 (1.08 – 1.21)***	1.07 (0.97 – 1.18)	1.04 (0.96 – 1.14)	1.04 (0.99 – 1.08)
18:3 Gamma-linolenic acid (GLA)	0.12 (0.00 – 19.41)	1.03 (0.04 – 25.99)	6.73 (0.21 – 215.04)	-	2.10 (0.19 – 23.81)
20:2	0.72 (0.13 – 4.03)	1.38 (0.50 – 3.82)	1.48 (0.29 – 7.57)	1.15 (0.22 – 6.14)	1.13 (0.44 – 2.93)
20:3 Dihomo gamma-linoleic acid (DHGLA)	1.13 (0.82 – 1.56)	1.67 (1.27 – 2.20)***	1.26 (0.82 – 1.93)	1.19 (0.81 – 1.75)	1.06 (0.86 – 1.32)
20:4 Arachidonic acid (AA)	1.11 (0.98 – 1.27)	1.18 (1.06 – 1.31)**	1.16 (0.97 – 1.39)	1.18 (1.01 – 1.39)*	1.04 (0.95 – 1.13)
22.2	1.28 (0.42 – 3.84)	0.29 (0.10 – 0.87)*	0.46 (0.07 – 3.19)	1.24 (0.32 – 4.78)	0.97 (0.45 – 2.09)
22:4	1.35 (0.23 – 8.03)	0.57 (0.12 – 2.78)	0.21 (0.01 – 7.15)	1.47 (0.17 – 12.48)	1.52 (0.45 – 5.12)

*P ≤0.05; ** P ≤0.01; ***P≤ 0.001

Seafood consumption of fish, rock lobster, squid, abalone and oyster categorized into ever (≥ once a month versus never)

Table 3.10 Unadjusted logistic regression models for seafood intake and serum phospholipid (% weight) in relation to asthma outcomes (continued)

Type of fatty acid	ASTHMA OUTCOMES				
	Asthma symptoms	NSBH	Current Asthma	Doctor diagnosed asthma	Atopy
n-3 series polyunsaturated					
18:3 Alpha-linolenic acid (ALA)	-	0.18 (0.00 – 15.20)	-	-	0.63 (0.17– 23.17)
20:0	1.91 (0.51 – 7.08)	0.63 (0.19 – 2.07)	2.30 (0.42 – 12.60)	0.64 (0.09 – 4.56)	0.59 (0.22 – 1.64)
20:5 Eicosapentaeoic acid (EPA)	0.95 (0.79 – 1.14)	0.68 (0.56 – 0.82)***	0.71 (0.50 – 1.01)	0.81 (0.62 – 1.06)	0.98 (0.87 – 1.11)
22.5 Docosapentaenoic acid (DPA)	0.87 (0.44 – 1.73)	0.38 (0.21 – 0.69)**	0.29 (0.09 – 0.96)*	0.75 (0.31 – 1.81)	1.15 (0.74 – 1.80)
22.6 Docosahexaenoic acid (DHA)	1.06 (0.91 – 1.23)	1.01 (0.89 – 1.14)	1.00 (0.80 – 1.24)	1.09 (0.90 – 1.31)	1.01 (0.91 – 1.12)
24:0	1.30 (0.71 – 2.37)	0.46 (0.26 – 0.82)**	0.95 (0.38 – 2.39)	0.59 (0.25 – 1.43)	1.13 (0.75 – 1.72)
Total					
n-6	1.01 (0.96 – 1.07)	1.14 (1.08 – 1.20)***	1.08 (0.99 – 1.18)	1.07 (0.99 – 1.14)	1.03 (0.99 – 1.06)
n-3	1.00 (0.92 – 1.09)	0.92 (0.85 – 0.99)*	0.92 (0.80 – 1.05)	0.98 (0.88 – 1.09)	1.00 0.95 – 1.06)
n-6:n-3 ratio	1.01 (0.84 – 1.20)	1.26 (1.09 – 1.46)**	1.21 (0.96 – 1.52) -	1.05 (0.85 – 1.31)	1.03 (0.91 – 1.16)

* P ≤ 0.05; ** P ≤ 0.01; ***P ≤ 0.001

Table 3.11 Multivariate logistic regression models for seafood intake and serum phospholipid (% weight) in relation to asthma outcomes

Type of fatty acid	Asthma outcomes				
	Asthma symptoms	NSBH	Current Asthma	Doctor diagnosed asthma	Atopy
Seafood consumption					
Fish	-	-	-	-	0.59 (0.08 – 4.20)
Rock lobster / prawns	0.54 (0.32 – 0.92)*	1.06 (0.66 – 1.71)	0.65 (0.29 – 1.44)	1.03 (0.52 – 2.03)	1.04 (0.71 – 1.53)
Squid (calamari)	0.80 (0.48 – 1.34)	1.10 (0.72 – 1.69)	0.81 (0.38 – 1.73)	1.35 (0.71-2.56)	1.18 (0.83 – 1.66)
Abalone (perlemoen)	1.08 (0.63 – 1.86)	1.30 (0.84 – 2.00)	0.95 (0.43 – 2.10)	0.74 (0.36 – 1.52)	1.08 (0.75 -1.54)
Oyster (mussel)	0.60 (0.36 – 0.99)*	0.93 (0.61 – 1.43)	0.44 (0.21 – 0.92)*	1.08 (0.57 – 2.03)	1.22 (0.86 – 1.73)
n-9 series polyunsaturated fats					
18:1 Oleic acid	0.97 (0.83 – 1.14)	0.86 (0.74 – 0.99)*	0.85 (0.65 – 1.10)	0.92 (0.74 – 1.14)	1.04 (0.94 – 1.48)
n-6 series polyunsaturated					
18:2 Linolenic acid (LA)	0.99 (0.93 – 1.06)	1.14 (1.07 – 1.22)***	1.07 (0.96 –1.18)	1.05 (0.96 – 1.14)	1.04 (0.99 – 1.08)
18:3 Gamma- linolenic acid (GLA)	0.12 (0.00 – 19.42)	0.93 (0.04 – 24.37)	8.15 (0.25 – 268.95)	-	2.12 (0.19 – 24.08)
20:2	0.75 (0.14 – 4.11)	1.36 (0.47 – 3.98)	1.51 (0.29 – 7.82)	1.35 (0.26 – 7.01)	1.11 (0.43 – 2.89)
20:3 Dihomo gamma-linoleic acid (DHGLA)	1.14 (0.83 – 1.57)	1.84 (1.38 – 2.47)***	1.32 (0.86 – 2.03)	1.22 (0.83 -1.79)	1.06 (0.85 – 1.32)
20:4 Arachidonic acid (AA)	1.12 (0.98 – 1.27)	1.21 (1.08 – 1.35)***	1.18 (0.98- 1.43)	1.20 (1.02 – 1.40)*	1.04 (0.95 – 1.13)
22.2	1.41 (0.46 – 4.32)	0.28 (0.09 – 0.85)*	0.46 (0.06 – 3.35)	1.30 (0.32 – 5.26)	0.96 (0.44 – 2.09)
22.4	1.37 (0.23 – 8.06)	0.48 (0.10 – 2.33)	0.19 (0.01 – 6.17)	1.67 (0.20 – 14.29)	1.48 (0.44 – 5.02)

* P ≤ 0.05; ** P ≤ 0.01; ***P ≤ 0.001
Seafood consumption of fish, rock lobster, squid, abalone and oyster categorized into ever (< / > once a month versus never)

Table 3.11 Multivariate logistic regression models for seafood intake and serum phospholipid (% weight) in relation to asthma outcomes continued

Type of fatty acid	ASTHMA OUTCOMES				
	Asthma symptoms	NSBH	Current Asthma	Doctor diagnosed asthma	Atopy
n-3 series polyunsaturated					
18:3 Alpha-linolenic acid (ALA)	_	0.16 (0.00 – 15.72)	-	4.79 (0.01 – 1543.55)	0.67 (0.02 – 25.11)
20:0	2.12 (0.56 – 7.99)	0.49 (0.14 – 1.69)	2.22 (0.39 – 12.64)	0.67 (0.09 – 4.91)	0.59 (0.21 – 1.65)
20:5 Eicosapentaeoic acid (EPA)	0.95 (0.79 – 1.14)	0.66 (0.54 – 0.80)***	0.70 (0.49 – 1.00)	0.81 (0.62 – 1.06)	0.98 (0.87 – 1.11)
22.5 Docosapentaenoic acid (DPA)	0.90 (0.45 – 1.80)	0.37 (0.20 – 0.69)**	0.31 (0.09 – 1.03)	0.76 (0.31– 0 .82)	1.16 (0.74 – 1.81)
22.6 Docosahexaenoic acid (DHA)	1.06 (0.91 – 1.24)	1.01 (0.90 – 1.15)	1.00 (0.81– 1.25)	1.09 (0.91 – 1.31)	1.01 (0.92 – 1.12)
24:0	1.32 (0.72 – 2.41)	0.46 (0.25 – 0.83)**	0.93 (0.36 – 2.39)	0.59 (0.24 – 1.41)	1.13 (0.75 – 1.72)
Total					
n-6	1.01 (0.96 – 1.07)	1.14 (1.08 – 1.21)***	1.08 (0.99 – 1.18)	1.07 (1.00 – 1.15)	1.03 (0.99 – 1.6)
n-3	1.00 (0.92 – 1.10)	0.92 (0.85 – 0.99)*	0.92 (0.81 – 1.05)	0.98 (0.88 – 1.09)	1.00 (0.95 – 1.06)
n-6:n-3 ratio	1.00 (0.83 – 1.20)	1.24 (1.07 – 1.45)**	1.20 (0.95 – 1.52)	1.06 (0.85 – 1.32)	1.03 (0.91 – 1.16)

Adjusted for age, gender and smoking
* P ≤ 0.05; ** P ≤ 0.01; ***P ≤ 0.001

3.7 HOST FACTORS AND OCCUPATIONAL EXPOSURES ASSOCIATED WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE OUTCOMES

The four COPD-related outcomes considered were those of chronic bronchitis ("yes to reporting a chronic productive cough for three months in two consecutive years"); FEV_1/ FVC <70% (evidence of airway obstruction); FEV_1 / FVC <70% and absence of NSBH (evidence of fixed obstruction); and FEV_1/ FVC <70% and post-bronchodilator FEV_1 < 80% predicted (definitive COPD according to South African Thoracic Society (SATS) guideline).[15] The prevalence of chronic bronchitis was 3% whilst 5% displayed evidence of airway obstruction and 3% had fixed irreversible obstruction. There were 3% who had COPD according to the SATS guideline. In the unadjusted logistic regression models increasing age was associated with COPD outcomes whilst female gender was protective for all COPD outcomes except for chronic bronchitis symptoms (Table 3.12). Surprisingly, there was no association between smoking and any of the COPD outcomes despite the high prevalence of smoking in this population. Stratification to examine for possible effect modification by gender or age did not influence these findings (data not shown).

Multivariate logistic regression analysis revealed that a past medical history of TB treatment was significantly and positively associated with all COPD outcomes except for chronic bronchitis symptoms (Table 3.13). A history of recurrent childhood infections was also strongly predictive of COPD outcomes the effect being most marked for predicting current airway obstruction

(FEV_1 / FVC <70%) (OR, 19.65; 95% CI, 6.35 – 60.81). A history of ocular-nasal symptoms as well as being on current hayfever treatment were strongly associated with chronic bronchitis symptoms, whilst being on asthma treatment was associated with both chronic bronchitis symptoms and evidence of current airway obstruction (FEV_1/FVC<70%). Among the occupational factors chest symptoms due to episodes of peak occupational exposures was associated with a six-fold increase in the odds of having chronic bronchitis symptoms (OR, 6.23; 95% CI 2.42 – 16.04) whilst work-related ocular-nasal symptoms was associated with a fourfold increased odds (OR 4.22, 95%CI, 1.64 – 10.87). The effect on chronic bronchitis symptoms was strongest for those who experienced tight chest or wheeze as a result of workplace exposures (OR, 11.34; 95% CI, 4.24 – 30.31). The PAF for TB and recurrent chest infections in childhood in relation to fixed airway obstruction were 20.1% and 51.2% respectively.

Table 3.12 Unadjusted logistic regression models for the association between demographic characteristics, occupational and environmental exposures and COPD outcomes in seafood processing workers along the West Coast of the Western Cape

Demographic characteristics	COPD OUTCOMES			
	Chronic bronchitis symptoms	Airway obstruction (FEV1 / FVC < 70%)	Fixed airway obstruction (FEV / FVC < 70% and absence of NSBH)	COPD (FEV / FVC < 70% and post-bronchodilator FEV1 <80% predicted)
Prevalence (%)	**19/ 642 (3%)**	**31 / 582 (5%)**	**19/582 (3%)**	**17 /643 (3%)**
Age (yrs)	1.04 (1.00 -1.08)	1.09 (1.05 – 1.13)***	1.09 (1.05 – 1.14)***	1.09 (1.05 – 1.14)***
Female gender	0.75 (0.30 – 1.90)	0.24 (.11 – 0.53)***	0.14 (0.05 – 0.42)***	0.16 (0.05 – 0.50)**
Smoking				
- Non-smoker	1.00	1.00	1.00	1.00
- Ex-smoker	2.79 (0.73 – 10.67)	1.95 (0.63 – 6.04)	1.70 (0.30 – 9.48)	1.7 (0.30 – 9.48)
- Current	1.49 (0.50 – 4.40)	1.37 (0.60 – 3.14)	2.45 (0.79 – 7.60)	2.06 (0.65 – 6.54)
Past medical history				
Previous treatment for tuberculosis	2.58 (0.90 – 7.35)	3.17 (1.40 – 7.19)**	4.34 (1.65 – 11.36)**	5.22 (1.93 – 14.14)***
Previous treatment for chronic bronchitis	7.84 (3.02 – 20.33)***	1.36 (0.46 – 4.04)	0.52 (0.07 – 3.98)	0.59 (0.08 – 4.52)
Previous treatment for recurrent chest infections in childhood	4.93 (1.55 – 15.72)**	7.64 (3.10 – 18.83)***	3.36 (0.93 – 12.10)	5.71 (1.76 – 18.51)**
History of allergic disease				
Ocular-nasal symptoms	3.88 (1.54 – 9.73)**	0.78 (0.31 – 1.94)	0.38 (0.09 – 1.67)	0.43 (0.10 – 1.92)
Hayfever in childhood	1.14 (0.15 – 8.84)	-	-	-
Current asthma treatment	15.96 (5.73 – 44.47)***	5.11 (1.78 – 4.68)**	1.18 (0.15 – 9.18)	1.33 (0.17 – 10.42)
Current hayfever treatment	19.90 (6.10 – 64.93)***	1.28 (0.16 – 10.05)	-	0.45 (0.06 – 3.45)

Chronic bronchitis symptoms: Yes to reporting a chronic productive cough for 3 months in 2 consecutive years
* P ≤ 0.05; ** P ≤ 0.01; ***P ≤ 0.001

Table 3.12 Unadjusted logistic regression models for the association between demographic characteristics, occupational and environmental exposures and COPD outcomes in seafood processing workers along the West Coast of the Western Cape continued

	COPD OUTCOMES			
Prevalence	**Chronic bronchitis symptoms**	**Airway obstruction (FEV_1 / FVC < 70%)**	**Fixed airway obstruction (FEV_1 / FVC < 70% and absence of NSBH)**	**COPD (FEV_1 / FVC < 70% and post-bronchodilator FEV_1 <80% predicted)**
	19/ 642 (3%)	**31 / 582 (5%)**	**19/582 (3%)**	**17 /643 (3%)**
Occupational characteristics and exposures				
Current job status				
Seasonal vs. permanent	0.77 (0.37 – 1.57)	0.35 (0.16 – 0.72)**	0.25 (0.09 – 0.65)**	0.30 (0.11 – 0.83)*
Occupational exposure to steam, gasses, dust or fumes	2.03 (0.66 – 6.18)	1.05 (0.49 – 2.28)	1.16 (0.43 – 3.08)	1.75 (0.56 – 5.43)
Extent of occupational exposure to dust, mist spray in current job	1.00 (0.35 – 2.86)	0.71 (0.31 – 1.63)	0.85 (0.31 – 2.33)	1.00 (0.35 – 2.86)
Excessive vs. no exposure				
Episode of peak exposure causing wheezy chest or cough	6.19 (2.44 – 15.75)***	1.77 (0.79 – 3.96)	1.51 (0.53 – 4.27)	2.34 (0.85 – 6.45)
Work related chest symptoms	10.87 (4.16 – 28.28)***	1.72 (0.72 – 4.12)	1.06 (0.30 – 3.70)	1.76 (0.56 – 5.53)
Work-related ocular-nasal symptoms	3.99 (1.58 – 10.09)**	0.52 (0.20 – 1.39)	0.32 (0.07 – 1.39)	0.36 (0.08 – 1.59)

Chronic bronchitis symptoms: Yes to reporting a chronic productive cough for 3 months in 2 consecutive years
* P ≤ 0.05; ** P ≤ 0.01; ***P ≤ 0.001

Table 3.13 Multivariate logistic regression models for the association between demographic characteristics, occupational and environmental exposures and COPD outcomes in seafood processing workers along the West Coast of the Western Cape

Demographic characteristics	COPD OUTCOMES			
	Chronic bronchitis symptoms*	Airway obstruction (FEV_1 / FVC < 70%)	Fixed airway obstruction (FEV_1 / FVC < 70% and absence of NSBH)	COPD (FEV_1 / FVC < 70% and post-bronchodilator FEV_1 <80% predicted)
Prevalence	**19/ 642 (3%)**	**31 / 582 (5%)**	**19/582 (3%)**	**17 /643 (3%)**
Past medical history				
Previous treatment for tuberculosis	2.33 (0.80 – 6.78)	2.98 (1.23 – 7.25)**	3.63 (1.28 – 10.32)*	4.47 (1.54 –13.01)***
Previous treatment for chronic bronchitis	8.49 (3.14 – 22.97)***	1.58 (0.50 – 5.04)	0.65 (0.08 –5.31)	0.72 (0.09 – 5.88)
Previous treatment for recurrent chest infections in childhood	5.53 (1.68 – 18.25)**	19.65 (6.35 – 60.81)***	5.84 (1.35 – 25.26)*	10.65 (2.69 – 42.15)***
History of allergic disease				
No. with ocular-nasal symptoms	4.16 (1.63 –10.62)**	0.71 (0.27 – 1.88)	0.39 (0.08 – 1.85)	0.43 (0.09 – 2.06)
No. with hayfever in childhood	1.01 (0.12 – 8.28)	-	-	-
No. on current asthma treatment	15.48 (5.09 – 47.08)***	5.00 (1.51 – 16.53)**	1.11 (0.13 – 9.81)	1.20 (0.14 – 10.65)
No on current hayfever treatment	18.81 (5.37 – 65.93)***	0.79 (0.09 – 7.25)	-	-
Occupational characteristics and exposures				
Current job status				
Seasonal vs. permanent	0.64 (0.18 – 2.28)	1.94 (0.66 –5.70)	1.44 (0.41 – 5.15)	1.94 (0.51 – 7.36)
Occupational exposure to steam, gasses, dust or fumes	2.01 (0.65 – 6.25)	1.09 (0.48 – 2.47)	1.08 (0.39 – 3.04)	1.73 (0.54 – 5.61)
Extent of occupational exposure to dust, mist spray in current job	1.02 (0.34 – 3.01)	0.51 (0.21 – 1.26)	0.52 (0.17 – 1.56)	0.66 (0.21 – 2.05)
Excessive vs. no exposure				
Episode of peak exposure causing wheezy chest or cough	6.23 (2.42 – 16.04)***	1.78 (0.76 – 4.17)	1.50 (0.50 – 4.50)	2.42 (0.83 – 7.07)
Work related chest symptoms	11.34 (4.24 – 30.31)***	1.95 (0.76 – 5.05)	1.14 (0.30 – 4.36)	2.00 (0.59 – 6.80)
Work-related ocular-nasal symptoms	4.22 (1.64 – 10.87)**	0.54 (0.19 – 1.50)	0.37 (0.08 – 1.68)	0.41 (0.09 – 1.91)

Adjusted for age, gender and smoking

***Chronic bronchitis symptoms**: Yes to reporting a chronic productive cough for 3 months in 2 consecutive years; P ≤ 0.05; ** P ≤ 0.01; ***P ≤ 0.001

CHAPTER FOUR: DISCUSSION

This study allowed for the examination of the determinants of obstructive lung disease in a working population using self-reported symptoms, spirometry and non-specific challenge tests to develop outcome variables for asthma and COPD. This resulted in a more accurate estimate of the prevalence of obstructive lung disease in a geographic subpopulation (Western Cape) in South Africa and more detailed analysis of the determinants of these disease outcomes in this population.

Whilst most studies have identified occupational exposure as an important and significant predictor of obstructive lung disease, little is known about its prevalence in the South African working population outside the mining industry and the contribution of the various risk factors to the disease burden. Examination of the relationship of host factors, occupational exposures, allergic sensitization and dietary consumption of polyunsaturated fatty acids to obstructive lung disease, enabled the quantification of attributable burden of some of these risk factors. The findings of this study should lead to greater understanding of the role and contribution of the various risk factors to the obstructive lung disease burden and inform preventative strategies aimed at reducing the morbidity and mortality associated with these conditions.

It is generally well recognized that there is considerable overlap between asthma and COPD with respect to symptomatology, treatment and diagnosis from both the patient and physician perspective.[2,15] The prevalence for asthma outcomes in this study ranged from 6 -11% whilst COPD prevalence

was remarkably consistent at 3 - 5% across all COPD outcomes. This prevalence for COPD is slightly higher than that found by Ehrlich et al in the large population-based study of South African adults (P, 1.5% in men; P, 1.9% in women). [7] However this may be related to the age structure of the population as the national survey included a large proportion of young adults between the ages of 15-23 which is lower than the average age of subjects in this current study (mean, 34 years).

Our study also found a significantly higher percentage of men versus women (10% versus 3%) with evidence of obstructive lung disease (FEV_1/FVC <70%) which is in keeping with the results of other studies in developing countries.[16,17] There was also a clear sex difference with respect to the prevalence of NSBH, being twice as common in women compared to men (P, 30% in women; P, 14% in men). The association between female sex and NSBH has also been reported in a recent South African study by van Schalkwyk et al (OR, 3.6; 95%CI, 1.8-7.0) in the Cape metropolitan area. This may in part explain the differences in the epidemiology of asthma between males and females with respect to both asthma prevalence and severity. [42] Some of these differences have also been ascribed to "immune dimorphism", a term describing the difference in immune responses and regulation between the two sexes.[43] In this population, occupational factors such as gender-based job allocations in the seafood-processing industry may also result in women experiencing higher exposures to respiratory irritants and allergens and therefore being more at risk of developing asthma.[44] Of interest too is the high prevalence of smoking among a relatively young predominantly female

worker population (62%) which is considerably higher than the population norm of 34% as described by Ehrlich et al.[5]

The reported prevalence of allergic ocular-nasal symptoms in this study is relatively high, whilst the prevalence of those on treatment is surprisingly low. The low numbers of respondents on treatment for asthma and ocular-nasal symptoms may reflect both under-diagnosis and under-treatment of these conditions which is a common finding in developing countries.[45] It may also in part reflect difficulty with access to appropriate healthcare services for the treatment of these conditions. This is an important issue to address in health service provision for chronic respiratory disease since upper airway symptoms are an important risk factor for lower airway disease.[54]

A medical history of treatment for chronic bronchitis and recurrent chest infections in childhood demonstrated a significant association with all asthma outcomes. The population attributable fraction of recurrent chest infections in childhood in relation to a diagnosis of current asthma was high (42.5%). This underscores the importance of pre-existing respiratory disease in the manifestation of asthma in this population as has been well illustrated in the life course approach to chronic diseases (Figure 4).[46] It has certainly been recognized that respiratory viral infections may influence the course of asthma at different time points and animal data suggests that the link between respiratory viral infections and increased asthma is causally related, with viral infections acting on the immune and structural cells to enhance antigen presentation and inflammatory cell recruitment.[47] Similarly, a strong and

consistent relationship between a childhood history of treatment for recurrent chest infections and COPD was also demonstrated in this study. This suggests that recurrent respiratory infections in childhood may markedly increase susceptibility to the development of COPD in adult life most likely through its negative impact on lung function.

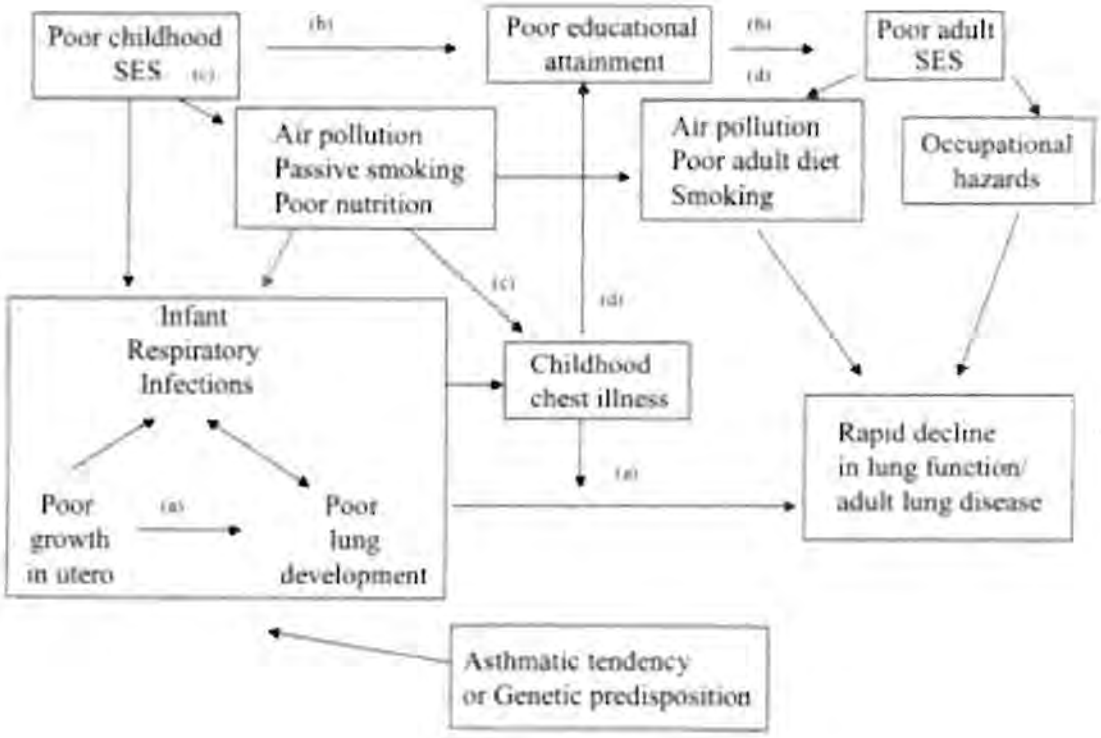

Figure 4 depicting a schematic representation of biological and psychosocial exposures acting across the life course that may influence lung function and/or respiratory disease

Source Ben-Shlomo Y, Kuh D. A life course approach to chronic disease epidemiology: conceptual models, empirical challenges and interdisciplinary perspectives. Int J Epid 2002;31:285-293

This study also demonstrated that a past history of pulmonary tuberculosis emerged as a strong and significant predictor for all COPD outcomes. This was similar to the findings of Ehrlich et al. [7] Similarly, in a recent community survey of Cape Town residents, Jithoo et al found that TB was strongly associated with symptoms of obstructive lung disease such as recent wheeze (OR, 2.1; 95% CI, 1.5 – 2.9), wheeze with breathlessness (OR, 1.9; 95%CI 1.3 – 2.7) and dyspnoea grade 2 or higher (OR, 2.1; 95%CI, 1.5 – 2.9).[48] In South Africa, airway obstruction has also been documented in 18.4% of gold miners who had previously been treated for TB.[49] In this group of miners chronic lung function impairment was shown to increase incrementally with the number of episodes of tuberculosis reported. In the clinical context, Wilcox et al reported the presence of airflow obstruction in up to 68% of patients who had previously been treated for TB.[50] While little is known about the pathophysiology underlying this association, residual damage to lung tissue following completion of TB has been demonstrated resulting in varying degrees of fibrosis, bronchovascular distortion, emphysema and bronchiectasis. [49] In this current study, the population attributable fraction for TB in relation to fixed airway obstruction was 20.1% suggesting that a focus on TB prevention and appropriate management may substantially reduce the morbidity associated with obstructive lung disease in this population. Given the high prevalence of TB in this population and the considerable impact of COPD symptoms on quality of life; this is an area that warrants further investigation.

One of the surprising findings in this study showed that whilst smoking was positively associated with COPD outcomes, the association was not significant. This is in contrast to the national population-based studies that showed a significant if complex association between chronic bronchitis symptoms and heavy smoking (>15 cigarettes /day) in men (OR, 2.5; 95%CI, 1.2 – 5.3) and light smoking (1 – 14 cigarettes) in women (OR, 2.3; 95%CI, 1.4 – 3.8).[7] The population attributable fraction of chronic bronchitis related to smoking reported by Ehrlich et al was 25% in men and 11% in women illustrating the public health impact of this important risk factor. The lack of an association in this current study is unexpected given the high prevalence of smoking in this population and the well-known aetiological role of smoking in COPD. Furthermore, detailed analysis showed that the association was not modified by either age or sex. However, the point estimates for the association between current smoking and fixed obstruction is similar to that found in other studies and the lack of significance at alpha=0.5 appears to be due mainly to the much smaller sample size imposing a lack of power in demonstrating underlying associations. [37] The use of the GOLD definition of airway obstruction may also have resulted in younger people with obstructive lung disease being classified as normal.[51] More recent ATS /ERS guidelines have proposed a new definition of airway obstruction as a reduction of FEV_1/FVC below the fifth percentile of the predicted value for an individual, to counter the problem of misclassification.[52]

The importance of occupational factors in the epidemiology of obstructive lung disease has been extensively reviewed and it is estimated to contribute 15%

of the excess cases of obstructive lung disease in the general population.[1] In this current study, the occupational factor that continued to have a strong and consistent relationship with all asthma outcomes was the presence of work-related tight chest or wheeze which showed a twofold increase in the risk of having NSBH (OR, 2.01; 95% CI, 1.19 -3.40). This is consistent with the results of the community survey by Van Schalkwyk et al that demonstrated a very strong association between NSBH and work-related wheeze or tight chest (OR, 6.00; 95%CI, 2.5 – 14.5).[12] In this current study, workers who reported experiencing peak exposures to dusts, fumes and gases in the workplace were also found to be at far higher risk of having current asthma (OR, 3.7; 95% CI 1.72 – 7.93) or doctor-diagnosed asthma (OR, 2.56; 95%CI, 1.31 – 5.02). Both these associations are probably mediated through the irritant effects on the respiratory system caused by exposure to bioaerosols, microorganisms and toxins present in the work environment associated with seafood processing.[53] In the multivariate analysis work-related ocular-nasal symptoms was also associated with asthma symptoms (OR, 3.13; 95% CI, 1.83 – 5.35) and chronic bronchitis symptoms (OR, 4.22; 95%CI, 1.64 – 10.87). The association between ocular-nasal symptoms and the development of asthma symptoms is consistent with findings from studies performed in occupational settings.[54,55] There is also increasing evidence for an interaction between upper and lower airways in the development and severity of asthma and rhinitis, which has led to the term *united airways* implying the two should be considered a common immunopathologic entity.[56]

In examining the relationship with COPD outcomes, occupational factors were highly predictive of chronic bronchitis symptoms but not for spirometry-based definitions of COPD. This may in part be related to the relatively young age of the population and the short duration (mean, 10 years) of occupational exposure that may not be long enough for lung function decline to become apparent.[37] Consideration should also be given to the impact of selection bias manifesting as the 'healthy worker effect' as subjects who smoke heavily and who have symptoms of asthma or COPD may be less likely to seek employment or may have left the industry earlier leaving behind workers with generally better health status. Symptom-based diagnoses are also more vulnerable to information bias as it relies on participants' understanding and recall of relevant symptoms which may not always be accurate.

In this study, atopy was associated with all asthma outcomes with the strongest association occurring with respect to current asthma (OR, 3.42; 95%CI, 1.62 – 7.24). Allergic sensitization is known to be associated with a large proportion of adult asthma and ongoing allergen exposure may also predispose to an enhanced response to a second allergen.[2,42] The strong association between atopy and asthma outcomes was driven mainly by sensitization to indoor allergens of which house dust mite was the predominant allergen causing sensitization. Sensitivity to any one of the indoor allergens was also strongly associated with all asthma outcomes. Despite a low prevalence of *Aspergillus* sensitization (2%) in this population, sensitization to *Aspergillus* was strongly associated with asthma symptoms (OR, 5.02; 95%CI, 1.63 -15.45) and doctor-diagnosed asthma (OR, 3.90;

95%CI, 1.05 – 14.54). A similar association with the presence of NSBH (OR, 2.5; 95%CI, 1.00 – 6.00) has been observed in a much larger community-based study by van Schalkwyk et al suggesting a consistent association with asthma outcomes. [12]

In this current study seafood intake was high ranging from 28% for abalone to 99% for fish. These seafoods are known to be rich in omega-3 fatty acids. The n-6 polyunsaturated fatty acids dihomo-gamma linoleic acid, linolenic acid and arachidonic acid were associated with an increase in the risk of NSBH with arachidonic acid also predictive of doctor-diagnosed asthma. This supports results from a previous study and is consistent with the pro-inflammatory role of n-6 PUFAs hypothesized to play a role in the pathogenesis of asthma.[31,32] Similarly, the negative association of n-3 PUFAs with NSBH in particular suggests that diets rich in EPA, DPA and 24:0 may confer some protection against the development of asthma. This effect is biologically plausible as n-3 PUFAs shunt eicosanoid production away from the arachidonic pathway resulting in a decreased production of bronchoconstrictive leukotrienes. [57] The lack of a relationship between atopy and serum fatty acid levels is however contrary to studies in children that have demonstrated a role for n-6 PUFAs in atopy and have implicated dietary change as an important factor in the growing prevalence of asthma and allergic disease.[31] The findings of this current study and that by Wood at al suggest that the relationship between atopy and serum fatty acids is of less importance in adults with asthma whilst the consistent relationship with NSBH demonstrated requires further investigation.

The use of spirometry-based diagnoses is strength of this study and represents an attempt to overcome some of the biases related to the use of self-reported symptoms in defining outcomes. However the consistency between spirometry based diagnoses and symptom- based diagnoses suggests that symptom--based diagnoses were quite robust and sensitive in this population. A limitation is the cross cross-sectional design which makes it impossible to determine temporal sequence required to infer causality. Although consideration has been given to the healthy worker effect it is difficult to ascertain how large an impact this would have had on the prevalence of obstructive lung disease in this population. The agreement between our estimates and that found in a national survey suggests that such an impact was not marked.

In conclusion, it is recommended that future research focus on the further investigation of the pathophysiology underlying the strong association between TB and obstructive lung disease. Public health policies geared at the successful prevention and management of the TB epidemic may well lessen the burden posed by obstructive lung disease. There is also a need for prospective studies examining occupational exposures to characterize the nature and directionality of associations between occupational exposures and obstructive lung disease. Given the important contribution of occupational exposure to the burden of obstructive lung disease in general, greater effort should be expended to decrease environmental exposure to respiratory irritants and allergens in the workplace. Furthermore, the potential protective

relationship between dietary polyunsaturated fats and asthma is biologically plausible and presents an opportunity for further research as dietary manipulation may well present a cost-effective way to lessen the burden of obstructive lung disease.

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UCT OCCUPATIONAL SEAFOOD ALLERGY STUDY IN SOUTH AFRICA - 2001

ENGLISH QUESTIONNAIRE

Card 1

RECORD NO: _____ ☐☐☐ 1-3

A. IDENTIFICATION DATA

1. Surname _____

2. First name/s _____

3. Address _____

_____

_____

4. Work number _____ ☐☐☐☐☐☐ 4-9

5. Date of birth Day ____ Month ____ Year 19 ___ ☐☐☐☐☐☐ 10-15

6. Gender Male _____ (1) ☐ 16
Female _____ (2)

7. Home language English ____ (1) ☐ 17
Afrikaans ____ (2)
Xhosa ____ (3)
Other ____ (4)

8. Interviewer's initials _____ ☐ 18

9. Date of interview Day ____ Month ____ Year 20 ____ ☐☐☐☐☐☐ 19-24

10. Factory_____ ☐ 25

11. Shift Day ____ (1) ☐ 26
Night ____ (2)

B. HEALTH

I am going to ask you some questions about your health. At first these will be mostly about your breathing. Wherever possible, I would like you to answer 'YES' or 'NO'.

Circle (O) appropriate responses.

Wheeze and tightness in the chest

1. Have you had wheezing or whistling in your chest at any time in the last ***12 months***?

YES (1) NO (2) ☐27

If YES, go on to Question 1.1
If NO, skip to Question 2

1.1 Have you been short of breath when the wheezing noise was present?

YES (1) NO (2) ☐28

1.2 Have you had this wheezing or whistling when you ***did not*** have a cold or flu?

YES (1) NO (2) ☐29

2. Have you been woken up with a feeling of tightness in your chest at any time in the last ***12 months?***

YES (1) NO (2) ☐30

Shortness of breath

3. Have you had an attack of shortness of breath that came on during the daytime when you were at rest at any time in the last ***12 months?***

YES (1) NO (2) ☐31

4. Have you had an attack of shortness of breath that came on following running or exercise at any time in the last ***12 months?***

YES (1) NO (2) ☐32

5. Have you been woken by an attack of shortness of breath at any time in the last ***12 months?***

YES (1) NO (2) ☐33

Cough and phlegm from the chest

6. Have you been woken by an attack of coughing at any time in the last ***12 months?***

YES (1) NO (2) ☐34

7. Do you ***usually*** cough first thing in the morning?

YES (1) NO (2) ☐35

8. Do you ***usually*** cough during the rest of the day, or at night?

YES (1) NO (2) ☐36

If YES, go on to Question 8.1
If NO, skip to Question 9

8.1 Do you cough like this on most days/nights for as much as three or more months in each of the last two years?

YES (1) NO (2) ☐37

9. Do you usually bring up any phlegm from your chest first thing in the morning?

YES (1) NO (2) ☐38

10. Do you usually bring up any phlegm from your chest during the day, or at night?

YES (1) NO (2) ☐39

If YES, go on to Question 10.1
If NO, skip to Question 11

10.1 Do you bring up phlegm like this on most days/nights for as much as three or more months in each of the last two years?

YES (1) NO (2) ☐40

Breathing

11. Do you ever have trouble with your breathing?

YES (1) NO (2) ☐41

If YES, go on to Question 11.1
If NO, skip to Question 12

11.1 Do you have this trouble: ☐42

Give all options at once
Insert a cross (X) next to one answer only

a) continuously so that your breathing is never quite right? ___
b) repeatedly, but it goes away completely between the times when it troubles you? ___
c) only rarely? ___

12. Are you disabled from walking by a condition ***other than*** heart or lung disease?

YES (1) NO (2) ☐43

If YES, state the condition _____
and go on to Question 13
If NO, go to Question 12.1

12.1 Are you troubled by shortness of breath when hurrying on level ground or walking up a slight hill?

YES (1) NO (2) ☐44

If YES, go on to Question 12.1.1
If NO, skip to Question 13

12.1.1 Do you get short of breath walking with other people of your own age on level ground?

YES (1) NO (2) ☐45

If YES, go on to Question 12.1.1.1
If NO, skip to Question 13

12.1.1.1 Do you have to stop for breath when walking at your own pace on level ground?

YES (1) NO (2) ☐46

Asthma

13. Have you ever had asthma?

YES (1) NO (2) ☐47

If YES, go on to Question 13.1
If NO, skip to Question 13.8

13.1 ***If yes***, was this confirmed by a doctor?

YES (1) NO (2) ☐48

13.2 How old were you when you were told you have asthma? ☐49

Give all options at once
Insert a cross (X) next to one answer only

a) Only before you were 17 years old ____
b) Only at the age of 17 years or older ____
c) Both ____

The following references to "attack" of asthma refers to episodes of wheezing, shortness of breath, chest tightness or cough attributed to asthma

13.3.1 How old were you when you had your first **attack** of asthma?

_____ years old ☐☐50-51

13.3.2 How old were you when you had your most recent **attack** of asthma?

_____ years old ☐☐52-53

13.4.1-6 Which months of the year do you usually have attacks of asthma?

13.4.1 January/February YES (1) NO (2) ☐54

13.4.2 March/April YES (1) NO (2) ☐55

13.4.3 May/June YES (1) NO (2) ☐56

13.4.4 July/August YES (1) NO (2) ☐57

13.4.5 September/October YES (1) NO (2) ☐58

13.4.6 November/December YES (1) NO (2) ☐59

13.5 Have you had an attack of asthma in the last ***12 months?***

YES (1) NO (2) ☐60

If YES, go on to Question 13.5.1
If NO, skip to Question 13.6

13.5.1 How often have you had an attack of asthma in the last ***12 months?*** ☐61

Give all options at once
Insert a cross (X) next to one answer only

a) Every day ____
b) More than 2 times a week ____
c) More than 1 time per month ____
d) 3 to 12 times in the whole year ____
e) 1 to 2 times in the whole year ____

13.6 Are your chest symptoms caused by, or made worse by any of the following:

Answer all questions

13.6.1 Contact with animals/pets YES (1) NO (2) ☐62

13.6.2 Grass or flowers YES (1) NO (2) ☐63

13.6.3 Heavy exercise YES (1) NO (2) ☐64

13.6.4 Breathing cold air YES (1) NO (2) ☐65

13.6.5 Dusts or sprays at work YES (1) NO (2) ☐66

13.6.6 Tobacco smoke YES (1) NO (2) ☐67

13.6.7 Change in the weather YES (1) NO (2) ☐68

13.7 Do your chest symptoms seem better or worse when you are away from work (for example, on weekends, off-shift and vacations)? ☐69

Give all options at once
Insert a cross (X) next to one answer only

a) Stay the same ____
b) Get better ____
c) Get worse ____

13.8 Does being at work ever make your chest tight or wheezy?

YES (1) NO (2) ☐70

If YES, go on to Question 13.8.1
If NO, skip to Question 13.9

13.8.1 When did you first notice having problems with chest tightness or wheeze at work?

Date: Month ____ Year ____ ☐☐☐☐71-74

13.8.2 Is there anything that you work with that causes you to have these chest symptoms?

YES (1) NO (2) ☐75

If YES, go on to Question 13.8.3
If NO, skip to Question 13.9

13.8.3 What do you think is causing these symptoms?

_____ ☐76

13.9 Have you ever had to change or leave your work area, either temporarily or permanently, in this factory or any other factory because of any chest symptoms?

Card 2

YES (1) NO (2) ☐1

If YES, go on to Question 13.9.1
If NO, skip to Question 13.10

13.9.1 What type of job were you doing when this happened?

_____ ☐☐2-3

13.9.2 Was this a job in this factory?

YES (1) NO (2) ☐4

If YES, go on to Question 13.9.2.1
If NO, skip to Question 13.10

13.9.2.1 What department did you move to?

_____ ☐☐5-6

13.9.2.2 What job did you do there?

_____ ☐☐7-8

13.9.2.3 Did your symptoms improve when you changed jobs?

YES (1) NO (2) ☐9

13.10 Have you ever worked in a job or jobs that exposed you to vapours, gas, dust or fumes?

YES (1) NO (2) ☐10

If YES, go on to Question 13.10.1. List the jobs beginning with the most recent
If NO, skip to Question 13.11

13.10.1 What was or is this job? _____ ☐☐ 11-12
(if current job write 'current job')

13.10.2 Before that? _____ ☐☐ 13-14

13.10.3 Before that? _____ ☐☐ 15-16

13.11 Has there ever been an instance when you inhaled a large amount of vapours, gas, dust or fumes in any of these jobs that resulted in you developing a tight chest, wheeze or cough?

YES (1) NO (2) ☐ 17

If YES, go on to Question 13.11.1.
If NO, skip to Question 13.12

13.11.1 What was or is this job? _____ ☐☐ 18-19
(if current job write 'current job')

13.12 Are you using any medicines, including inhalers/pumps, nebulizers, syrups or tablets, for asthma or breathing problems?

YES (1) NO (2) ☐ 20

If YES, go on to Question 13.12.1, showing examples of each
If NO, skip to question 13.13

13.12.1 Which medicines? _____ ☐ 21

_____ ☐ 22

_____ ☐ 23

13.12.2 Do you take these medicines every day even when you do not have any trouble breathing?

YES (1) NO (2) ☐ 24

13.13 Have you ever been treated for any of the following:

Answer all questions

13.13.1 Repeated chest infections as a child YES (1) NO (2) UNK (3) ☐25

13.13.2 Tuberculosis (TB) YES (1) NO (2) UNK (3) ☐26

13.13.3 Chronic bronchitis YES (1) NO (2) UNK (3) ☐27

Nose and eye symptoms

14. Have you ever had any nose or eye problems or allergies such as hay fever?

YES (1) NO (2) ☐28

14.1 How old were you when you ***first*** noticed these symptoms?

_____ years old ☐☐29-30

If YES, go on to Question 14.2 Answer all questions
If NO, skip to Question 14.4

14.2 During the past ***12 months*** have you had two or more episodes of:

14.2.1 sneezy, itchy or runny nose when you did not have a cold or flu?

YES (1) NO (2) ☐31

14.2.2 red, itchy or watery eyes YES (1) NO (2) ☐32

14.2.3 Do you usually have the nose or eye symptoms at any particular time of the year? YES (1) NO (2) ☐33

14.2.3.1 If YES, which is the ***worst*** season? ☐34

Give all options at once
Insert a cross (X) next to one answer only

a) Winter ___
b) Spring ___
c) Summer ___
d) Autumn ___

If YES to any of the above, go on to Question 14.3
If NO, skip to Question 14.4

14.3 Do your nose or eye symptoms seem better or worse when you are away from work (for example, on weekends, off-shift and vacations)? ☐35

Give all options at once
Insert a cross (X) next to one answer only

a) Stay the same ____
b) Get better ____
c) Get worse ____

14.4 Does being at work ever cause you to have sneezy/itchy/runny nose or red/itchy/watery eyes?

YES (1) NO (2) ☐36

If YES to any one of the above, go on to Question 14.4.1
If NO, skip to Question 14.6

14.4.1 Since when have you been having these symptoms at work?

Date: Month ____ Year ____ ☐☐☐☐37-40

14.4.2 Is there anything that you work with that causes you to have these symptoms?

YES (1) NO (2) ☐41

If YES, go on to Question 14.4.3
If NO, skip to Question 14.5

14.4.3 What do you think is causing these symptoms?

_____ ☐42

14.5 Are you using any medicines, including nose sprays, drops, tablets or injections, for your nose or eye symptoms at present?

YES (1) NO (2) ☐43

If YES, go on to Question 14.5.1
If NO, go on to Question 14.6

Present a chart with different samples of allergy medicines (N.B. a worker might show you his/her medicines).

14.5.1 Which medicines? _____ ☐44

_____ ☐45

14.6 Did you have hay fever (itchy or watery eyes/nose) as a child?

YES (1) NO (2) ☐46

Skin symptoms

15. Have you ever had any kind of skin problem either at home or at work?

YES (1) NO (2) ☐47

If YES, go on to Question 15.1
If NO, skip to Question 15.4.4

15.1 How old were you when you ***first*** noticed this skin problem?

_____ years old ☐☐48-49

15.2 During the past ***12 months*** have you had any skin problems that occurred 2 or more times?

YES (1) NO (2) ☐50

If ***Yes,*** which of the following problems did you have?

Go through each option in the table below and circle the appropriate response.

	Forearms Hands	**Face / Neck**	**Legs Knees**	**Whole Body**
15.2.1 itchy or scratchy skin	Yes/No ☐51	Yes/No ☐52	Yes/No ☐53	Yes/No ☐54
15.2.2 hives ("bommels")	Yes/No ☐55	Yes/No ☐56	Yes/No ☐57	Yes/No ☐58
15.2.3 dry, scaly skin	Yes/No ☐59	Yes/No ☐60	Yes/No ☐61	Yes/No ☐62

	Forearms Hands	Face / Neck	Legs Knees	Whole Body
15.2.4 redness of the skin	Yes/No ☐63	Yes/No ☐64	Yes/No ☐65	Yes/No ☐66
15.2.5 blisters or weeping skin	Yes/No ☐67	Yes/No ☐68	Yes/No ☐69	Yes/No ☐70
15.2.6 burning skin	Yes/No ☐71	Yes/No ☐72	Yes/No ☐73	Yes/No ☐74
15.2.7 started within an hour of contact with a substance or food item	Yes/No ☐75	Yes/No ☐76	Yes/No ☐77	Yes/No ☐78
15.2.8 Other? Specify: _____	Yes/No ☐1 Card 3	Yes/No ☐2	Yes/No ☐3	Yes/No ☐4

If YES, to any of the above go on to Question 15.3
If NO, skip to Question 15.4

15.3 Do your skin problems seem better or worse when you are away from work (for example, on weekends, off-shift and vacations)?

☐5

Give all options at once
Insert a cross (X) next to one answer only

a) Stay the same ____
b) Get better ____
c) Get worse ____

15.4 Does being at work ever cause you to have skin problems?

YES (1) NO (2) ☐6

If YES, go on to Question 15.4.1
If NO, skip to Question 15.4.4

15.4.1 Since when have you been having these skin problems at work?

Date: Month ____ Year ___ ☐☐☐☐7-10

15.4.2 Is there anything that you work with that makes these skin problems worse?

YES (1) NO (2) ☐11

If YES, go on to Question 15.4.3
If NO, skip to Question 15.4.4

15.4.3 What do you think is causing these skin problems?

_____ ☐12

15.4.4 Have you ever cut or injured your fingers or hands while working with the seafood?

YES (1) NO (2) ☐13

15.4.5 Do you wear gloves while working?

YES (1) NO (2) ☐14

If YES, go on to Question 15.4.5.1
If NO, skip to Question 15.5

15.4.5.1 How often do you wear these gloves while working? ☐15

Give all options at once
Insert a cross (X) next to one answer only

a) most of the time ____
b) less than half the time ____
c) occasionally ____

15.4.5.2 How often do you change these gloves? ☐16

Give all options at once
Insert a cross (X) next to one answer only

a) daily ____
b) weekly ____
c) monthly ____
c) yearly ____

15.4.5.3 Which type of glove are you using most of the time while working?

Ask workers to choose from the selection and place the number in the space provided below

Glove used: _____ ☐17

15.4.5.4? Do you use any other gloves while working? YES (1) NO (2) ☐18

If yes, which ones? (choose from the same selection)

a) _____ ☐19

b) _____ ☐20

15.4.5.5 Are your gloves washed at the end of each shift?

YES (1) NO (2) ☐21

15.4.5.6 Are your gloves washed with a disinfectant on a regular basis (almost every day)?

YES (1) NO (2) ☐22

15.4.5.7 Are your hands still wet even though you use gloves while working?

YES (1) NO (2) ☐23

15.5 How many times do you wash your hands in the course of a day? ☐24

Give all options at once
Insert a cross (X) next to one answer only

0 ____
1 time ____
2-3 times ____
4-5 times ____
6 or more ____

15.6 Are you using any medicines, including any creams or ointments, for your skin problems at present?

YES (1) NO (2) ☐25

If YES, go on to Question 15.6.1
If NO, skip to next question 15.7

15.6.1 Which medicines? _____ 26

_____ 27

15.7 Did you have eczema as a child? YES (1) NO (2) 28

Other allergic conditions

16. Are you allergic to insect stings or bites? YES (1) NO (2) 29

If YES, go on to Question 16.1
If NO, skip to Question 17

16.1.1-3 What kind of reactions do you have?

16.1.1 Breathing difficulty, feeling faint, fever? YES (1) NO (2) 30

16.1.2 Redness, itching or swelling at the sting site YES (1) NO (2) 31

16.1.3 Other: _____ 32

17. Have you ever had any difficulty with your breathing after taking medications or injections that you did not have before?

YES (1) NO (2) 33

If YES, go on to Question 17.1
If NO, skip to 18.1

17.1 Which medicines? _____ 34

18.1-6 When you are near animals (such as cats, dogs or horses), near feathers (including pillows, quilts or duvets), near grass and flowers, or in a dusty part of the house, do you ***ever***

18.1 Start to cough? YES (1) NO (2) 35

18.2 Start to wheeze? YES (1) NO (2) 36

18.3 Get a tight chest? YES (1) NO (2) 37

18.4 Start to feel short of breath? YES (1) NO (2) 38

18.5 Get a runny/stuffy nose or sneeze? YES (1) NO (2) ☐39

18.6 Get itchy or watery eyes? YES (1) NO (2) ☐40

18.7 Get itchy skin/rash? YES (1) NO (2) ☐41

19. Have you ever had an illness or trouble caused by eating a particular type of food/fruit or drinking a particular juice/drink?

YES (1) NO (2) ☐42

If YES, go on to Question 19.1
If NO, skip to 20

19.1 What type of food/drink was this?

_____

_____

19.1.1-6 Did this illness or trouble include:

19.1.1 Itchy skin or rash YES (1) NO (2) ☐43

19.1.2 Diarhoea or vomiting YES (1) NO (2) ☐44

19.1.3 Runny or stuffy nose YES (1) NO (2) ☐45

19.1.4 Severe headaches YES (1) NO (2) ☐46

19.1.5 Breathlessness/tight chest/wheeze YES (1) NO (2) ☐47

19.1.6 Other: _____ ☐48

19.2 Was the food canned or preserved? YES (1) NO (2) ☐49

19.3 Do you experience these problems when you drink fizzy drinks also? YES (1) NO (2) ☐50

20. Are you allergic to seafood such as fish, crabs, prawns, lobster, mussels?

YES (1) NO (2) ☐51

If YES, go on to Question 20.1
If NO, skip to next **Section C** on **FAMILY HISTORY**

20.1.1-9 What kind of reactions do you have?

20.1.1 hives/itchy wheals YES (1) NO (2) ☐52

20.1.2 eczema YES (1) NO (2) ☐53

20.1.3 nausea/vomiting/stomach pain/ diarhoea YES (1) NO (2) ☐54

20.1.4 wheezing/tight chest/ difficulty breathing YES (1) NO (2) ☐55

20.1.5 itching of tongue/lips YES (1) NO (2) ☐56

20.1.6 swelling/itching of throat YES (1) NO (2) ☐57

20.1.7 dizziness/collapse YES (1) NO (2) ☐58

20.1.8 fever/general weakness/joint pains YES (1) NO (2) ☐59

20.1.9 Other: _____ ☐60

20.2 When do you experience these reactions?

20.2.1 After eating seafood YES (1) NO (2) ☐61

20.2.2 After touching seafood YES (1) NO (2) ☐62

20.2.3 After smelling seafood YES (1) NO (2) ☐63

20.3 Which seafood do you suspect are causing the symptoms?

20.3.1 Hake	YES (1) NO (2)	☐64
20.3.2 Snoek	YES (1) NO (2)	☐65
20.3.3 Mackerel	YES (1) NO (2)	☐66
20.3.4 Anchovy	YES (1) NO (2)	☐67
20.3.5 Sardines (pilchard)	YES (1) NO (2)	☐68
20.3.6 Red eye	YES (1) NO (2)	☐69
20.3.7 Mussels	YES (1) NO (2)	☐70
20.3.8 Perlemoen	YES (1) NO (2)	☐71
20.3.9 Crayfish	YES (1) NO (2)	☐72
20.3.10 Prawns	YES (1) NO (2)	☐73
20.3.11 Haarders (bokkom)	YES (1) NO (2)	☐74
20.3.12 Other _____		☐75

20.4 When did you first experience these reactions?

20.4.1 Before working in the seafood industry	YES (1) NO (2)	☐76
20.4.2 After beginning work in the seafood industry	YES (1) NO (2)	☐77

20.5 Have you ever experienced any of these reactions during or after working or handling seafood?

See list of reactions under question 20.1 if a reminder is needed

Card 4

YES (1) NO (2) ☐1

If YES, go on to Question 20.5.1
If NO, skip to next **Section C** on **FAMILY HISTORY**

20.5.1 What were you busy doing? _____ ☐2

20.5.2 Where were you handling/working with the seafood?

20.5.2.1 at work YES (1) NO (2) ☐3

20.5.2.2 at home YES (1) NO (2) ☐4

20.5.2.3 recreational activities (fishing, diving)

YES (1) NO (2) ☐5

20.5.2.4 Other? Specify _____ ☐6

20.5.3 What reaction/s did you experience?

_____ ☐7

20.5.4 What seafood/s were you working with?

_____ ☐8

20.5.5 When did the reaction occur?: ☐9

Give all options at once
Insert a cross (X) next to one answer only

a) within 1hour ___
b) within 1 to 3 days ___
c) after 3 days ___

C. FAMILY HISTORY

1. Do/did any members of your family (blood relatives) ever have any kind of allergies?

Do not include relatives by marriage If family history is completely unknown (subject is adopted, etc.), mark UNK and do ***not*** complete table. Move to next section

YES (1) NO (2) UNK (3) ☐ 10

If YES, complete table below. Insert a cross (X) in the appropriate block for each option.

Type of Allergy	**NO ONE** in family	**YES**, present in the family			**DO NOT KNOW**	
		Parent	Brother /sister	Child		
1.1 Hay fever	1	2	3	4	5	11
1.2 Eczema	1	2	3	4	5	12
1.3 Asthma	1	2	3	4	5	13
1.4 Seafood Allergy	1	2	3	4	5	14
1.5 Other allergy _____ _____	1	2	3	4	5	15

D. SMOKING HISTORY

1. Have you **ever smoked** tobacco (cigarettes or pipe) for as long as a year?

'YES' means at least 20 packs of cigarettes or 360 grams of tobacco in a lifetime or at least one cigarette per day for one year

YES (1) NO (2) ☐16

If YES, go on to Question 1.1
If NO, skip to Question 2

1.1 How old were you when you started smoking?

_____ years old ☐☐17-18

1.2 Do you **now** smoke?

'YES' means smoking tobacco in the last month or more

YES (1) NO (2) ☐19

If YES, go on to Question 1.2.1
If NO, skip to Question 1.3.1

1.2.1-2. How much do you **now** smoke on average?

1.2.1 Number of cigarettes per day_____ ☐☐20-21

1.2.2 Pipe tobacco in grams/week_____ ☐☐☐22-24

show different packets of tobacco for pipe smokers

1.3. Have you stopped smoking completely?

YES (1) NO (2) ☐25

If YES, go on to Question 1.3.1
If NO, skip to Question 1.4

1.3.1. How old were you when you stopped smoking completely?

_____ years old ☐☐ 26-27

1.3.1.1 How many years in total did you smoke cigarettes? (Do not include the years you stopped before you started again)

_____ years ☐☐ 28-29

1.3.2.1-2 ***On average*** of the entire time you smoked, how much did you smoke?

1.3.2.1 Number of cigarettes per day _____ ☐☐ 30-31

1.3.2.2 Pipe tobacco in grams/week _____ ☐☐☐ 32-34

1.4 Do you or did you inhale the smoke?

YES (1) NO (2) ☐ 35

2. Have you been regularly exposed to tobacco smoke from other people smoking cigarettes or pipe in the last 12 months?

'Regularly' means on most days or nights

YES (1) NO (2) ☐ 36

E. DIETARY HISTORY – SEAFOOD INTAKE

This section is on eating seafood.

1. How often have you eaten the following seafood in the last 12 months?

Go through each seafood option and insert a cross (X) in the block for each option

Type of seafood	**Never**	**Less than once a month**	**Once or more than once a month**	
1. Fish: fried, cooked canned or dried (eg. Haarders (bokkom), snoek, tuna, mackerel etc.)	1	2	3	37
2. Crayfish or prawns	1	2	3	38
3. Calamari	1	2	3	39
4. Perlemoen	1	2	3	40
5. Oyster/Mussels	1	2	3	41
6. Other: _____ _____	1	2	3	42

2. Have you changed your diet or avoided certain seafood because they do not agree with you when you eat them?

YES (1) NO (2) ☐43

If YES, go on to Question 2.1
If NO, skip to next **Section F** on **WORK HISTORY**

2.1 What seafoods have you avoided?

_____ ☐☐44-45

_____ ☐☐46-47

F. WORK HISTORY IN SEAFOOD PROCESSING

I am going to ask you about your present work

Use company record of work history, if available, to prompt worker's memory

1. How long have you been working at this factory?

_____ years ☐☐ 48-49

_____ months ☐☐ 50-51

Present job

2. How long have you been working in your current job?

_____ years ☐☐ 52-53

_____ months ☐☐ 54-55

3. In which department are you currently working? ☐☐ 56-57

_____

3.1 What is your job in this department? ☐☐ 58-59

Job Title _____

get a short description of the job

_____

_____

3.2 Do you ever do other jobs during your shift on a regular basis (almost every day)?

YES (1) NO (2) ☐ 60

If Yes, which jobs? _____ ☐ 61

_____ ☐ 62

3.3 Are you currently a seasonal, permanent or casual worker? ☐63

Give all options at once
Insert a cross (X) next to one answer only

a) Seasonal ____
b) Permanent ____
c) Casual ____

3.4 How much dust or mist/spray/steam would you say that this job produces: ☐64

Give all options at once
Insert a cross (X) next to one answer only

a) None ____
b) A little ____
c) An average amount ____
d) A lot ____

3.4.1 How far do you work from the source of the dust or mist/spray/steam? ☐65

Mention all options at once
Insert a cross (X) next to one answer only

a) Right next to the source ____
b) About 1-2 metres away ____
c) More than 2 metres away ____
d) Does not apply ____

3.5 Do you use any personal protective equipment on a **regular basis** (almost every day) while doing your job?

YES (1) NO (2) ☐66

If NO, skip to Question 4
If YES, continue with Question 3.5.1

3.5.1 Which of the following personal protective equipment do you use on a **regular** basis (almost every day)?

3.5.1.1 Goggles: YES (1) NO (2) ☐67

3.5.1.2 Gloves: YES (1) NO (2) ☐68

3.5.1.3 Mask: YES (1) NO (2) ☐69

3.5.1.4 Aprons: YES (1) NO (2) ☐70

3.5.1.5 Other: _____ ☐71

If NO to all of the previous questions, skip to Question 4
If YES to any one of the above questions, continue with Question 3.5.2

3.5.2 How long have you been wearing the personal protective equipment on a **regular** basis (almost every day) while working?

3.5.2.1 Goggles: _____ yrs ☐☐72-73

3.5.2.2 Gloves: _____ yrs ☐☐74-75

3.5.2.3 Mask: _____ yrs ☐☐76-77

3.5.2.4 Other: _____ yrs ☐☐78-79

Previous jobs in present factory

4. Before doing this job at this factory, did you do a different job here?

Card 5

YES (1) NO (2) ☐1

If NO, skip to question 5
If YES, continue with question 4.1

4.1 What other jobs did you do here?

Start with the first job and work forward, getting a one-line description of each job. If **casual** worker, denote each period of employment as a separate job. For continuous years of seasonal work consider as one job (provided no broken years service)

Job 1

4.1.1 Department _____ ☐☐ 2-3

4.1.2 Job Title _____ ☐☐ 4-5

get a short description of the job

_____

4.1.3 Seasonal/permanent/casual: _____ ☐ 6

4.1.4. How long did you work in this job? _____ years ☐☐ 7-8

_____ months ☐☐ 9-10

4.1.5 How much dust or mist/spray/steam would you say that this job produced: ☐ 11

Give all options at once
Insert a cross (X) next to one answer only

a) None ____
b) A little ____
c) An average amount ____
d) A lot ____

4.1.6 Which of the following personal protective equipment did you use on a **regular** (almost every day) basis while working?

4.1.6.1 Goggles: YES (1) NO (2) ☐ 12

4.1.6.2 Gloves: YES (1) NO (2) ☐ 13

4.1.6.3 Mask: YES (1) NO (2) ☐ 14

Job 2

4.2.1 Department _____ ☐☐ 15-16

4.2.2 Job Title _____ ☐☐ 17-18

get a short description of the job

_____

4.2.3 Seasonal/permanent/casual: _____ ☐ 19

4.2.4. How long did you work in this job? _____ years ☐☐ 20-21

_____ months ☐☐ 22-23

4.2.5 How much dust or mist/spray/steam would you say that this job produced: ☐ 24

Give all options at once
Insert a cross (X) next to one answer only

a) None ____
b) A little ____
c) An average amount ____
d) A lot ____

4.2.6 Which of the following personal protective equipment did you use on a **regular** (almost every day) basis while working?

4.2.6.1 Goggles: YES (1) NO (2) ☐ 25

4.2.6.2 Gloves: YES (1) NO (2) ☐ 26

4.2.6.3 Mask: YES (1) NO (2) ☐ 27

Job 3

4.3.1 Department _____ ☐☐ 28-29

4.3.2 Job Title _____ ☐☐ 30-31

get a short description of the job

4.3.3 Seasonal/permanent/casual: _____ ☐32

4.3.4. How long did you work in this job? _____ years ☐☐33-34

_____ months ☐☐35-36

4.3.5 How much dust or mist/spray/steam would you say that this job produced: ☐37

Give all options at once
Insert a cross (X) next to one answer only

a) None ____
b) A little ____
c) An average amount ____
d) A lot ____

4.3.6 Which of the following personal protective equipment did you use on a **regular** (almost every day) basis while working?

4.3.6.1 Goggles: YES (1) NO (2) ☐38

4.3.6.2 Gloves: YES (1) NO (2) ☐39

4.3.6.3 Mask: YES (1) NO (2) ☐40

Job 4

4.4.1 Department _____ ☐☐41-42

4.4.2 Job Title _____ ☐☐43-44

get a short description of the job

4.4.3 Seasonal/permanent/casual: _____ ☐45

4.4.4. How long did you work in this job? _____ years ☐☐ 46-47

_____ months ☐☐ 48-49

4.4.5 How much dust or mist/spray/steam would you say that this job produced: ☐ 50

Give all options at once
Insert a cross (X) next to one answer only

a) None ____
b) A little ____
c) An average amount ____
d) A lot ____

4.4.6 Which of the following personal protective equipment did you use on a **regular** (almost every day) basis while working?

4.4.6.1 Goggles: YES (1) NO (2) ☐ 51

4.4.6.2 Gloves: YES (1) NO (2) ☐ 52

4.4.6.3 Mask: YES (1) NO (2) ☐ 53

Reminder: Please do a general check to determine if the total number of years in each job adds up to the total number of years in this factory. Refer to company records if available.

Previous work in other seafood factories

5. Have you worked in any **other** seafood processing factories in the past two years?

YES (1) NO (2) ☐ 54

If NO, skip to question 6
If YES, continue with question 5.1

5.1 Why did you change jobs? ☐ 55

_____

5.2 What is the total amount of time you have worked in seafood processing factories ever since you started working?

Years_____ Months _____ ☐☐☐☐ 56-59

Previous work experience

6. Name all the previous factories that you have worked in, when not working in this factory or before coming to work in this factory:

Start with the most recent job and work backwards (including all other seafood processing factories and jobs done during the off-season)

Name of Company	What did the company make?	Job Title (what did you do?)	Date start (Year)	Date stop (Year)	Total (yrs)		
						60	61

THANK YOU FOR ANSWERING THE QUESTIONNAIRE