SICK BUILDING SYNDROME IN A UNIVERSITY HOSPITAL IN THAILAND

BY

PILAS SWANGSOONTHONWES

A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF
THE DOCTOR OF PHILOSOPHY
(OCCUPATIONAL AND ENVIRONMENTAL HEALTH)
FACULTY OF PUBLIC HEALTH
THAMMASAT UNIVERSITY
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FACULTY OF PUBLIC HEALTH

DISSERTATION

BY

PILAS SWANGSOONTHONWES

ENTITLED

SICK BUILDING SYNDROME IN A UNIVERSITY HOSPITAL IN THAILAND

was approved as partial fulfillment of the requirements for

the degree of Doctor of Philosophy (Occupational and Environmental Health)

on February 11, 2023

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ABSTRACT

This study investigated prevalence of sick building syndrome (SBS) and the relationship between occupant characteristics, work conditions, psychosocial factors, personality types, indoor air quality (IAQ), and SBS symptoms among back office workers at a Thai university hospital. It also explored independent variables from August to October 2020. Back office workers from 17 different departments were randomly selected as 165 samples. Participants completed questionnaires on work sensation and sick building syndrome symptom as well as personality type, providing data on occupant characteristics, work conditions, and psychosocial factors. Ten parameters of IAQ samples were collected by air sampler.

The result was 80% of participants that showed the prevalence of SBS symptoms. The highest prevalence (68.5%) was of less specific symptoms, while 41.8% of samples suffered from skin symptoms, with 40.6% suffering from eye and nose symptoms. The lowest prevalence (26.7%) was of throat symptoms. Three factors statistically associated with SBS were neuroticism (AOR=4.40, 95% CI=1.65-11.74), visual display terminal (AOR=3.42, 95% CI=1.10-10.61) and allergy history (AOR=2.83, 95%

CI=1.05-7.59). Temperature, relative humidity, formaldehyde, bacteria, and carbon dioxide (CO_2) did not meet Singapore Standard. SS 554: 2009 in some back office rooms.

Therefore, administrators may resolve the SBS problem through direct risk factors by an organizational action plan to achieve good indoor air quality and benefit from increased productivity.

Keywords: Sick building syndrome, Back office, Hospital, Allergy history, Work conditions, Psychosocial factors, Personality types, Indoor air quality.

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Pilas Swangsoonthonwes

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CHAPTER 1
INTRODUCTION

1.1 Background

Sick building syndrome (SBS) is a symptom occurred in buildings. It is well known to a particular demographic, primarily in European nations, the United States, Canada, and Australia. In Asia, there were SBS studied in Japan, Singapore, Malaysia, and Thailand. Several occupants who were inside the building experienced symptoms while they were there.

The worker who suffered from SBS showed different aspects such as reduced overtime, increased staff turnover, and changed jobs (1). SBS manifests in the increased absence and reduced productivity (2, 3). Many sufferers reported that SBS was causing widespread loss of productivity, approximately 20% of their productivity, and the same affected workers changed their job (1).

Workplace elements like high temperatures, humidity, photocopier use, sloppy office cleanliness, workloads, and low job satisfaction have been associated with SBS symptoms (4). SBS etiologies were occupational factors and involved using devices like computers, carbonless paper, photocopiers, fax machines, printers, etc (5-7). The psychosocial work environment was related to health (8). low extraversion and high neuroticism were related to anxiety and depression (9). Most experts believe that SBS may be a combination of different factors (10).

The prevalence of SBS symptoms was associated with many factors among hospital workers. Psychosocial, work climate, and indoor air pollutants influenced the SBS prevalence. Hospital workers' prevalence of SBS symptoms was influenced by a variety of variables. SBS prevalence was influenced by psychosocial factors, work climate, and indoor air pollutants. Specifically, psychosocial factors are job stress, job satisfaction, and social support. Low supervisor support and indoor air pollutants (such as carbon dioxide, volatile organic compounds, particulates, and bacteria) had

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significant SBS symptoms among hospital workers (2, 11, 12). The prevalence of SBS in hospitals in Thailand was 24.62% up to 70.80% (13-15).

Among hospital workers in downtown Bangkok, the prevalence of SBS was 70.8%. Age, gender, and chemical use were associated with SBS (15). Humidity, exposure to office equipment, and extremely hard work were linked to SBS in a Thai university hospital. The prevalence of sick building syndrome was 40.39% during the rainy and 41.54% during the summer (14). The prevalence of sick building syndrome was 24.62% in a hospital in Bangkok, where SBS symptoms occurred in the dermal, ocular, nasal, throat, and respiratory tract. Neurological SBS was related to an allergy (13).

This thesis describes a study to investigate the prevalence of SBS among back office workers who work in a hospital and the factors that influence the SBS prevalence. This study also investigated the association between personality type and psychosocial factors with SBS symptoms.

1.2 The objective of the study

1. To investigate the prevalence of sick building syndrome among back-office workers in the study areas.

2. To explore the occupant characteristics, work conditions, psychosocial factors, personality types, and indoor air quality (IAQ) among back-office workers.

3. To investigate the relationship between occupant characteristics, work conditions, psychosocial factors, personality types, IAQ, and sick building syndrome symptoms.

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1.3 Scope of study

This study investigated the SBS prevalence and relationship between risk factors and SBS among back-office workers in a university hospital in Thailand. It also explored the occupant characteristics, work conditions, psychosocial factors, personality types, and indoor air quality (IAQ).

The population in this study worked for the administration and support such as accounting, finance, and human resource. They always had worked in the current back office room for not less than 3 months and did not work closely with the patient. The air conditioning system in the room was a split-type system. They were 175 back-office workers who worked in 18 back office rooms of 17 different divisions.

1.4 Variable

1.4.1 Independent Variables

- Occupant characteristics included 4 variables: gender, age, and allergy history.
- Work conditions explained work related equipment, working hours/week, and absent days.
- Psychosocial factors included 3 factors strongly associated with SBS: job stress, job satisfaction, and social support.
- Personality types included 4 types: introvert, extrovert, stable, and neurotic.
- IAQ included 10 parameters: temperature (T), relative humidity (RH), carbon dioxide CO_2), carbon monoxide (CO), ozone (O_3), formaldehyde (CH_2O), total volatile organic chemicals (TVOCs), particulate, mould, and bacteria.

1.4.2 Dependent Variables

Sick Building Syndrome Symptoms is a condition in which building occupants experience one or more adverse health symptoms that appear to be related to time spent indoors but do not necessarily result in specific illnesses. Sick Building Syndrome Symptoms can lead to work absenteeism (5, 16, 17).

There were 5 symptom groups of SBS including (I) irritated, dry, or watering eyes (sometimes described as itching, tiredness, redness, burning, or difficulty wearing contact lenses); (II) irritated, runny, or blocked nose (sometimes described as congestion, nosebleeds, itchy or stuffy nose); (III) dry or sore throat (sometimes described as irritation, upper airway irritation or difficulty swallowing); (IV) dryness, itching or irritation of the skin, occasionally with a rash; (v) less specific symptoms such as headache, lethargy, irritability and poor concentration (18).

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1.5 Conceptual Framework

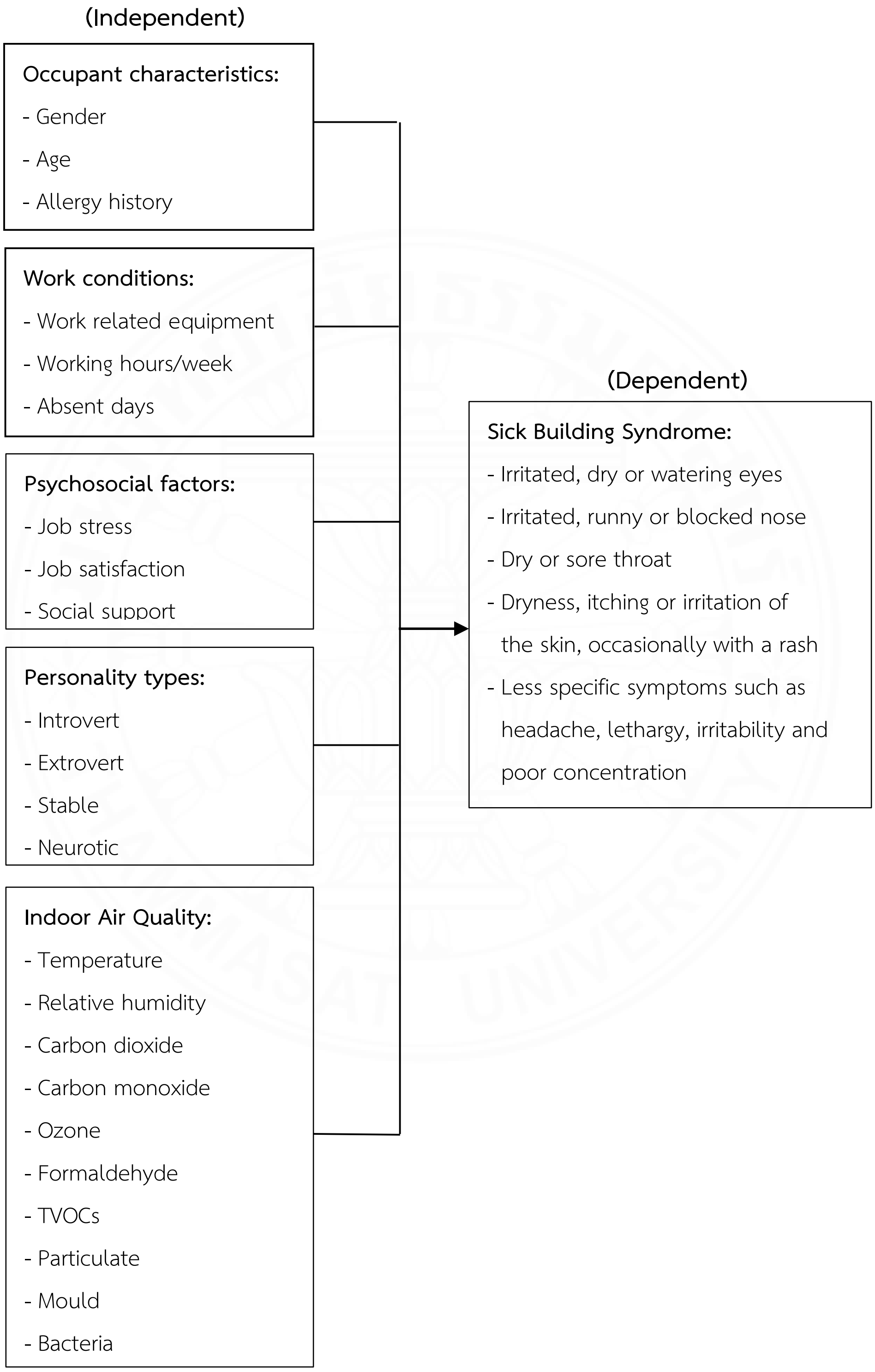

Figure 1.1 Conceptual framework of Sick Building Syndrome.

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CHAPTER 2
REVIEW OF LITERATURE

2.1 Sick Building Syndrome

2.1.1 Background

In the 1950s, sick building syndrome (SBS) appeared as the first noted symptom characteristic. The architects' main brief kept low costs as post-war development and airtight buildings. Energy-efficient correlated with SBS symptoms characteristic (1). Likewise, the first report of a syndrome of nonspecific symptoms affecting a wide range of organ systems after low-level exposure to chemicals commonly found in the environment was definitely in Idiopathic Environmental Intolerance or Multiple Chemical Sensitivities (MCS) (19).

In the 1960s, the Health and Safety Executive (HSE) first reported the issue of SBS. Many countries such as most European, Canada, the USA, Australia, and Japan reported that SBS emerged as a problem in the workplace (20, 21).

In the 1970s, the energy prices rose during the energy crisis, so all buildings became energy efficient. Then designing buildings focused on architectural techniques such as offices to be 'airtight, thus being more energy efficient and reducing thermal loss within the structure (20). Sealing up the building, the building manager and the engineer had to design and maintain the indoor environment more efficiently. Less ventilation rating was the result of electricity savings (22). The drive for energy efficiency reasoned buildings to become 'sick' (20).

Airtight buildings have replaced older, naturally ventilated buildings for energy-efficient then SBS has been reported more frequently (23). The medical profession's attention was the emergence of an allergic respiratory disorder among the workers working in air-conditioned offices (24). Patients had noticed increasing allergy symptoms by health care providers (25). SBS became more prevalent as a result of increased reporting and inquiry. More persons were affected by this recently discovered syndrome (20).

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Outbreaks of SBS first gained attention with more energy-efficient building development that depended on circulating fresh air mechanical ventilation systems. As well as to control temperature and humidity, functions may compete with others. Risen SBS was the increased use of synthetic materials in building construction. The number of workers employed in office settings and the automation of office work with greater regimentation and stress (23).

The SBS concept introduced the high prevalence of newer office buildings. These buildings were called ‘sick buildings’ as an occupational and environmental health issue. Epidemiological studies on SBS were performed in hospitals, schools, and office buildings (26). The elementary examination was physical risk factors that first studies appeared. The main reasons for mechanical systems and synthetic materials might relate to the thermally insulated building envelopes. Partly defined on the mechanical system level and thermally improved materials were solutions for lowering energy use (27).

The common issues in Malaysia also presented the SBS. The energy was efficient with the air conditioning system designed by the building construction. Indoor air pollutants (IAP) levels increased since poor services and maintenance of heating, ventilation, and air conditioning (HVAC) system (22). The National Institute for Occupational Safety and Health (NIOSH) was entrusted with developing and evaluating sampling and analytical procedures for workplace compliance assessments under the Occupational Safety and Health Act of 1970 (28).

In 1973, when ‘energy efficient’ offices were constructed onwards, as a result of the prohibition of oil trade between the country, 5 cubic feet per minute (cfm) per occupant of outdoor air that provided ventilation reduction measures called for national energy conservation. The minimized energy consumption achieved acceptable indoor air quality (IAQ) minimum of 15 cfm/person of outdoor air per person. That was a revised ventilation standard by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). There was an essential factor in SBS. Heating, ventilation, and air conditioning (HVAC) systems did not effectively

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distribute air to people in the building might be occurred inadequate ventilation (20, 29).

In 1974, under the Occupational Safety and Health Act of 1970, NIOSH and Occupational Safety and Health Administration (OSHA) jointly evaluated sampling and analytical methods for airborne contaminants (28).

In 1976, a hitherto unknown infectious disease was a severe illness outbreak that primarily the lungs affect that had probably developed in a cooling tower adjacent to the air conditioning systems. A previously unidentified bacterium was named Legionella. Legionnaire is not SBS. It is a building-related illness (BRI) (24).

In the 1980s, energy efficiency was an essential concern in an earlier decade. The organizations started adjusting their building designs as a result of the increase in energy expenses. As insulation requirements improved, ventilation rates decreased. An event was referred to as tight buildings. Responsibility for many cases of SBS was in low ventilation rate areas. Information technology (IT) began to rule the modern office throughout this decade as the microcomputer supplanted the mainframe. Chemicals used have increased as fire retardants, preservatives, and the base constituents of materials used in the office, such as furniture and floor coverings, without any change in recommended ventilation rates. The usage of photocopiers and laser printers, which emit the chemical ozone and can irritate at low concentrations, grew (30). The newly identified "common" issue increased awareness, and most stories started to be published (20). Some studies also looked at biological risk variables in addition to physical risk factors (27).

In 1983, the World Health Organization (WHO) first described situations of “Sick Building Syndrome” in which the occupants had acute experience comfort and health effects. But no specific illness or cause was identified when spent time in a building. SBS was the main cause of low efficiency of staff and employees and absence from work (6).

In 1984, up to 30% of remodeling and new buildings worldwide, IAQ might be related to the subject of excessive complaints suggested by WHO. It was often a temporary condition, but long-term problems have been some buildings.

Frequently, the result in operating or maintenance manner in a problem building was inconsistent with its original design or prescribed operating procedures. Sometimes poor building design or occupant activities were reasons for indoor air problems (29).

In 1987, the first edition of the Air Quality Guidelines for Europe was published by WHO. The activities culminated in the publication to provide a basis for protecting public health from the adverse effects of air pollutants, reducing or eliminating exposure to hazardous air pollutants, guide risk management decisions for local and national authorities. The European Region in other parts of the world followed these guidelines with great enthusiasm and widely applied in environmental decisions. Since the existing guidelines necessitated revising and updating, the risk assessment methodology that had taken place emerged with new data and new developments (31).

In the 1990s, some people living in renovated residential buildings or newly-built complain of various nonspecific subjective symptoms in Japan. SBS-related symptoms were similar to these symptoms and had been called "sick house syndrome" (32). Inadequate ventilation revised by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), the amount per occupant to 15 cfm, for offices raised to 20 cfm and for areas of specific use up to 60 cfm (minimum) where produced or might accumulate heavy pollution (20). Researchers realized that SBS also was influenced by psychosocial, personal, and other risk factors. Nevertheless, psychosocial, personality and other risk factors remain neglected research areas (27).

In 1993, the existing guidelines were necessary to update and revise after the first edition was published. New scientific data in epidemiology and air pollution toxicology emerged. The new developments in risk assessment methodology had taken place. The WHO European Centre for Environment and Health's Bilthoven Division took charge of the process in close coordination with WHO headquarters and the European Commission. More than 100 professionals participated in the scientific talks to prepare the text and participation. They led to the derivation of guideline values for several air pollutants. Their contribution and expert advice prepared the second edition of the guidelines. Effort possible and warmly acknowledged were

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financially supported by the European Commission, the Swedish Environmental Protection Agency, and the Government of the Netherlands (31).

In 1995, Singapore was a tropical climate. IAQ remained acceptable for ensuring a highly built environment energy conservation requirements pose constraints and challenges to the building industry. Comprising members privately and public sectors of the Technical Advisory Committee on Indoor Air Quality advised on the guidelines for good air quality. The issue of IAQ needed to be the first step toward interdisciplinary consensus in this document (33).

In 1996, the first edition of Guidelines for good IAQ in Office Premises was published by the Institute of Environmental Epidemiology Ministry of the Environment of Singapore. The goals of the publication were acceptable levels for particular parameters and general recommendations for improving the IAQ in air-conditioned office buildings. There was information on the health effects of indoor contaminants and a good IAQ action plan (33).

In 1997, the British medical journal, Lancet explained tiny amounts of chemicals escaping from paints, photocopiers, office supplies, carpets, and other sources that may make the air hazardous (34).

In the 2000s, The WHO released the second edition of the Air Quality Guidelines for Europe. Human health risks evaluation was present in part 2. There were indoor air pollutants such as carbon monoxide and formaldehyde (31).

In Thailand, SBS symptoms occur in different places such as hotels, office buildings, and hospitals. SBS among hospital workers in central Bangkok was associated with age, female, chemical use for work, poor sleep quality, and alcohol consumption. The most frequent symptoms were headache and difficulty concentrating, eyes, and nose. The prevalence of SBS was 70.8% (15). According to the symptoms, the organ systems were dermal, ocular, nasal, throat, respiratory tract, and neurological (13).

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2.1.2 Definition

The WHO identified SBS as a syndrome of complaints that includes generalized sensations of malaise, the onset of which was associated with the occupancy of certain modern buildings (Wilson and Hedge, 1987) (1). According to the definition of WHO, sick building was 25-30% of office personnel complain of building-related symptoms in cases of SBS (35).

The Oxford English Dictionary (OED, 1989) defines SBS as a syndrome of uncertain etiology consisting of non-specific, mild upper respiratory symptoms (stuffy nose, itchy eyes, sore throat), headache, and fatigue, experienced by occupants of 'sick buildings'; (also) the environmental conditions existing in such a building; abbreviated SBS is sick building syndrome (20). English Oxford Living Dictionaries defined a condition affecting office workers, typically marked by headaches and respiratory problems, attributed to unhealthy or stressful factors in the working environment, such as poor ventilation (36).

According to the National Safety Council (NSC), SBS was an acute health effect experience of the occupants that was linked to time spent in a building but could not identify as a specific cause or illness. May the localized complaints be a particular zone or room, or sometimes widespread throughout the building (29, 37-39).

SBS was called building-related symptoms (BRSs) (7). Workplaces were frequently associated with many symptoms and time spent in a particular building. Daily, SBS symptoms may manifest alone or in combination with other symptoms. Experience different symptoms in the same building in individual symptoms. Usually disappeared or improved altogether when they left out the building. When they re-entered the building, the symptoms often return (39-44).

SBS symptoms of the occupants occurred during working hours in the office and diminished or disappeared on holidays or weekends while leaving the buildings (17, 20).

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SBS indicates that people working in one building had these symptoms more than 20 percent when employees left the building. They decreased or disappeared dramatically symptoms (45). Periods of occupancy in the work site were associated with the symptoms. After workers left the worksite, the symptoms often disappeared (43, 46).

Two characteristics of SBS were different from BRI. First, no direct evidence of a single cause and effect mechanism. Causes of SBS were varied between buildings that cumulative and multiple. Secondly, psychological factors play a significant role in the causation (30).

Indicators of SBS include:

Sick building syndrome (SBS) is the acute health and comfort effects experienced by building occupants when the time spent in a building. The cause of SBS symptoms was not known. SBS is associated with building occupants' complaints of symptoms, e.g., eyes, nose, or throat irritation; headache; dry cough; itchy skin or dry; fatigue; nausea and dizziness; difficulty concentrating; and sensitivity to odors. Most of the relief of symptoms soon after occupants leave the building (29, 30).

Indicators of BRI include:

Building related illness (BRI) is the symptoms of a diagnosable illness that causes specific physical mechanisms, airborne building contaminants. The causes of symptoms can be clinically clearly identified. After leaving the building, occupants take a prolonged recovery time for the complaint and leave the building. Predominantly BRI symptoms are allergic effects (such as irritant reactions from micro-organisms that can thrive in building services), carcinogenic effects (such as lung cancers from asbestos and radon), infections (such as Legionnaires' Disease), toxic effects (such as the effects of vapor from solvents (29, 30).

Symptoms were described as the manifestation of any combination of a wide range of SBS in a population working in the same building. Signs of anxiety in afflicted people, overt symptoms, and sudden-onset were mass psychogenic illness characteristics that differ from a related construct SBS (44).

2.1.3 Etiology

Commission of the European Communities (1989), there were four major groups of risk factors for SBS (physical, chemical, biological, and psychological factors) (24).

Personal factors (gender, allergy history) might alter the propensity to report SBS symptoms and employee susceptibility (5, 45).

Stress was the psychological effect that control by occupants, such as job satisfaction and social support. Psychological factors influenced to development of an idea of a 'problem' or 'sick' building (1, 5, 39, 44, 45, 47).

Occupational factors included work related to equipment, such as computers, carbonless paper, photocopiers, fax machines, and printers. They were cited as the cause of the symptoms of SBS (5-7).

Occupant activities, colognes, or perfumes might be the source of indoor air pollutants by building occupants (48).

Furniture and finishing made of wood produce formaldehyde (CH2O) as pollutants in the indoor air, such as chairs, tables, and lockers. SBS was associated with new furnishings and office equipment that could release chemicals, known as VOCs, into the workplace (6, 20, 48-51).

The prevalence of sick building syndrome in the new building was higher than old building (52). Carbon dioxide (CO_2) levels increased while the poor ventilation rate in the old building. The new building was discovered to have excessive quantities of total volatile organic compounds (TVOCs) (22, 53). “Sick building” as a building had complained of related symptoms 20% or more of the occupants (20).

In renovation activities, the construction materials were sources of pollutants, dust, or other byproducts when painting and other renovations that might circulate through a building. Building furnishings, pollutants were released into the indoor air by furniture or cabinetry made of certain pressed-wood products (48).

Long-term using air-conditioning climate change was strongly associated with SBS (17). People who work in air-conditioned buildings are more likely to have SBS than those who work in naturally ventilated facilities (54).

Ventilation and air quality within the building were the possible major causes of SBS (1). Increased SBS symptoms were associated with low ventilation rates (55, 56).

Dampness due to high humidity and water leakage could because VOCs to form and cause symptoms, also etiology growth of microorganisms, mold, and bacteria. Damp buildings seemed to be causing respiratory symptoms (25). In the buildings with dampness, there were increased incidences of BRSs (56).

Inadequate office cleaning was statistically associated with SBS symptoms; however, cleaning agents, consumer products, and pesticides were the chief sources of indoor air pollutants that caused SBS (29, 57, 58).

According to risk factor analysis literature, from 1974 to 2014 there were recorded according to research fields/risk factors were 96 various sources of risk factors for SBS, 9 sources of biological risk factors, 15 sources of personal and other risk factors, 25 sources of physical risk factors, and 47 sources in chemical risk factors (27).

The risk factors for SBS were classified into six major groups, including physical, chemical, biological, psychosocial, personal, and others the comprehensive literature review, as shown in Table 2.1 (27).

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Table 2.1 Classified risk factors for SBS with their main parameters.

Risk factors of SBS	
Physical	environmental parameters of thermal comfort; universal design; parameters related to building ventilation; electromagnetic fields; noise vibrations; ergonomy; daylight; Ions.
Chemical	constructional and household products; environmental tobacco smoke; volatile organic compounds; man-mineral fibres; phthalates; odours; other indoor air pollutants.
Biological	microbes volatile organic compounds; house dust; moulds; bacteria.
Psychosocial	work organisation, supervision, communication; occupational stress; loneliness, helplessness; social status.
Personal	individual characteristics health status; gender.
Others	presence of insects, rodents, use of desinsection, deratization, desinfection products; location geopatogenic zones building characteristics; building characteristics; owership.

2.1.4 Effects from SBS

The majority (55%) of SBS sufferers showed total relief after leaving the workplace, whereas the remainder experienced partial relief (4). The employee suffered from SBS symptoms (8, 18). The productivity was directly related to SBS symptoms (3). SBS manifests were fatigue, a weakness that absence increased and reduced productivity from work (2, 3). There was a significant loss of production due to SBS. Many people who were afflicted claim to have a 20% reduction in productivity (1, 30). Employees absented most frequently reported SBS. Thirty-four percent less absenteeism was a large-scale study of Dutch workers in an office environment (17).

2.2 Symptom of Sick Building Syndrome

There were different classifications of SBS symptoms. WHO first defined first SBS syndrome in 1983. It was related to the workplace and includes typical symptoms such as eye, ear, nose, throat irritation, coughs, itchy skin, headache, nausea, mental fatigue, and dizziness (3, 59).

WHO defined the seven main symptom groups of SBS: (i) eye, nose, and throat irritation; (ii) sensation of dry mucous membrane and skin; (iii) erythema; (iv) mental fatigue; (v) headaches, high frequency of airway infections and cough; (vi) hoarseness, wheezing, itching, and unspecific hypersensitivity; (vii) nausea & dizziness (60).

The most common symptoms were stated by the World Health Organization Regional Office for Europe: (I) irritated, dry, or watering eyes (sometimes described as itching, tiredness, redness, burning, or difficulty wearing contact lenses); (II) irritated, runny, or blocked nose (sometimes described as congestion, nosebleeds, itchy or stuffy nose); (III) dry or sore throat (sometimes described as irritation, upper airway irritation or difficulty swallowing); (IV) dryness, itching or irritation of the skin, occasionally with a rash; (v) less specific symptoms such as headache, lethargy, irritability and poor concentration (18).

The SBS questions on subjective symptoms were derived from the Japanese version of MM040EA, five groups of symptoms for epidemiological assessment of SBS symptoms: (I) Dermal symptoms (itching, dry, flushed, and erupted skin); (II) General symptoms (tired, feeling heavy-headed, headache, having nausea, dizzy, and having difficulty concentrating); (III) Gular symptoms (hoarseness, dry throat, cough and wheezing), (IV) Optical symptoms (eye irritation); (V) nasal symptoms (running or blocked nose, and sneezing) (32). Risk factors of SBS were related to SBS symptoms, as shown in Table 2.2.

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Table 2.2 Risk factors of SBS with SBS symptoms.

Risk factor of SBS	SBS symptoms
Temperatures (T)	headache, fatigue, skin (dryness, irritation), ocular symptoms (itchy eyes, pain eye), sneezing (6, 25, 51, 61).
Relative humidity (RH)	headache, fatigue, dermal symptoms (dry skin, skin redness, rash), ocular symptoms (pain, watering or dry/itching eyes), respiratory symptoms (nasal congestion, sneezing, runny or itchy nose), dehydration and irritations to skin and mucous membranes (eye, nose and throat), cough, sore throat (6, 20, 25-27, 30, 51, 61).
Carbon dioxide (CO_2)	headache, nausea, dizziness, malaise, drowsiness, eye irritation, respiratory symptoms (nasal irritation, dyspnea, throat dryness, and difficulty concentrating) (6, 27, 42, 43, 46, 48, 51).
Carbon monoxide (CO)	headache, nausea, dizziness, impaired vision (25, 43, 46, 48, 51).
Ozone (O_3)	headache, nausea, eye irritation, skin irritation, respiratory tract discomfort, dry throat, cough (30, 43, 46, 51).
Formaldehyde (CH_2O)	headaches, dizziness, skin rashes, eyes irritatione, bleeding nose, respiratory irritation (25, 27, 30, 43, 46, 51).
Total Volatile organic Chemicals (TVOCs)	headache, nausea, dizziness, tiredness, fatigue, poor concentration, eye irritation (burning, dry, gritty, watery), dry throat, respiratory irritation, dermal symptoms, mucous membrane irritation (11, 30, 43, 46, 51, 62).
Particulate (PM)	dermal symptoms (itchy skin, skin irritation), respiratory symptoms nasal, ocular symptoms (irritation, itching and contact lens), mucosal symptom (7, 30).
Mould	headache, nausea, fatigue, cough, blocked nose, nose irritation, dry and sore throat, dry skin (11, 27, 43, 46).
Bacteria	headache, nausea, dizziness, fatigue, cough, sore throat (27, 43, 46).
Job stress	nausea, fatigue, headache, feeling heavy headed, eye symptoms (7, 12, 63).
Job satisfaction	headache, fatigue, mucosal irritations (6, 7, 12, 46, 59, 64, 65).
Social support	headache, nausea, fatigue, and feeling heavy headed (6, 7).

2.3 Occupant characteristics

2.3.1 Gender

The study reported SBS in significantly more women than men (7). Women had experienced SBS symptoms more than men in some countries, like the Netherlands, Finland, England, and Denmark. In Iran, general SBS symptoms among men were more than among women (54.42% and 45.58%) (3, 6).

More women than men have reported experiencing SBS's effects. It may be due to women's awareness of the issue and their lowered exposure to certain chemicals and IAPs (45, 61). The women might enhance their susceptibility to the favorable aspects of the environment, living situations, and working of might exposed to more strains and stresses (66).

The prevalence of genera symptoms and mucosal irritation was higher in women than men (56, 60, 64). The studies found that women usually reported environmental and work-related symptoms more often than men (5, 52, 67, 68).

2.3.2 Age

The psychosocial work environment connected with dermal symptoms in 18–44 years old (younger age group) than ≥45 years (older group) (63). In the occurrence of SBS symptoms, young occupants were less general SBS symptoms than older occupants (60).

2.3.3 Allergy history

A higher prevalence of SBS was associated with self-reported allergy (26). They self-reported mainly with the general symptom that SBS symptoms were associated with allergy. A study on personal factors as a predictor of SBS symptoms had shown allergy (56). Sensitivity to chemicals and mold allergies was related to personal characteristics (35).

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2.4 Work conditions

2.4.1 Work related equipment

General symptoms and mucosal irritation were associated with work related equipment such as work at video display terminals, photocopying, and handling of carbonless paper (65). Visual display unit work was associated with eye irritation. Exposure to particles emitted from laser printers or photocopiers used. The workplace was associated with stress and upper airway inflammation (7).

2.4.2 Working hours/week

A significant 92.5% of nurses who worked more than 60 hours per week were affected and had signs of SBS. The high prevalence of sick building syndrome symptoms in the nursing environment was associated with an unpleasant odor and high workload (2).

2.4.3 Absent days

Including the WHO believes SBS is the main cause of absence and low efficiency (6). SBS prevalence correlated to the number of times and days (5). SBS shown up as more absences and less productivity at work (2).

2.5 Psychosocial factors

Psychosocial factors were quite strongly associated with SBS research (35). Psychosocial factors, the etiology of SBS were work-related stress, job satisfaction, and lack of local control (1). The psychosocial work environment was related to health attributed to the physical work environment, which may resemble the work stress of physical responses. Psychosocial work characteristics had a significant impact on the risk of developing the symptoms of SBS, such as low job status, job stress, job dissatisfaction, poor social support, conflicting demands, heavy workload, worry, and reorganization (8, 23, 35, 45, 57, 59, 69, 70).

General symptoms and mucosal irritation were associated with psychosocial factors, but only to a minor extent to skin and mucous membrane irritations. High workload and limited influence at work were factors strongly related to a high prevalence of general symptoms, particularly work-related general symptoms (35, 64, 71). The psychosocial work environment was associated with dermal and mucous membrane symptoms (63).

2.5.1 Job stress

There was a significant relationship between SBS symptoms and job stress (5, 72). Stress levels often were correlated with SBS symptoms (41, 62). Working in a sick building environment arose stress associated with SBS (17). Job stress was a psychosocial risk factor, a negative impact on workplace productivity and profits with a detrimental effect on the health and wellbeing of employees. Some researchers investigated the possible links between SBS symptoms and occupational stress (27, 55).

Building related issues have been identified as SBS's synergistic effect. Interacting with employees could result in physical reactions or acute adverse emotional combined effects of these multiple stressors. Absenteeism, high turnover rates, and decreased productivity might be affected in the short term (43).

High work stress was the main significant factor related to the general symptoms of SBS. General work related symptoms were a crucial component of the earlier described work stress (71). SBS was associated with the nurse workload. Affect nurses in intensive care main stress factors were high working pressure and intensive care in hospitals in Canada (2).

2.5.2 Job satisfaction

SBS was significantly related to overall environmental satisfaction (Burge et al., 1987). Employees who perceived their environments reported a higher number of symptoms as less satisfactory (5).

Low job satisfaction was a psychosocial risk factor in the workplace that was negatively associated with SBS symptoms. Job satisfaction mentions

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employees like or dislike their jobs important organizational variable. Job satisfaction reported more SBS symptoms in lower female participants (73).

Work-related general symptoms and work-related mucosal irritation were associated with a quantity of work inhibiting job satisfaction and dissatisfaction with superiors or colleagues (12, 64, 65). Both prevalence of particulars, the incidence of new symptoms, and chronic symptoms were strongly related to a psychosocial dissatisfaction index (35).

2.5.3 Social support

Social support was one coping strategy sought from co-workers provided by the organization, including informational, emotional, and instrumental support. Low social support might be most susceptible to reporting negative health effects due to their place of work that was directly related to symptom severity associated with SBS. The lack of social support was stress susceptibility to SBS symptoms. Employees increased stress and lowered resistance to illness might be from a lack of organizational support. Little support in SBS environments may perceive sources employee (62). Among office workers, the risk of SBS may increase by low support from superiors and coworkers (55). General symptoms (nausea, headache, feeling heavy headed, fatigue, concentrating problems) were connected mainly to the lack of social support (63).

2.6 Personality traits

Eysenck Personality Questionnaire (EPQ) was based on the theory of personality traits by Prof. Eysenck. He was a renowned professor of human psychology. EPQ was described in a popular book. In 1972 first published “Know Your Own Personality” and used worldwide by the psychiatric profession. "Norm" cultural stereotypes were the idea of a test. It simply represents likely a typical person's response. Normal responses did not mean the 'right' or 'correct'. The idea is to expose fixed and conditioned ways of thinking, feeling, and behaving, not to indicate that any particular way is right or better than another.

Eysenck's Personality Inventory (EPI) consists of 2 dimensions; extraversion-introversion and neuroticism-stability. EPI measures personality traits containing 57 "Yes - No" items and interprets 4 personality types, Introvert, Extrovert, Stable, and Neurotic, as shown in figure 2.1 (74).

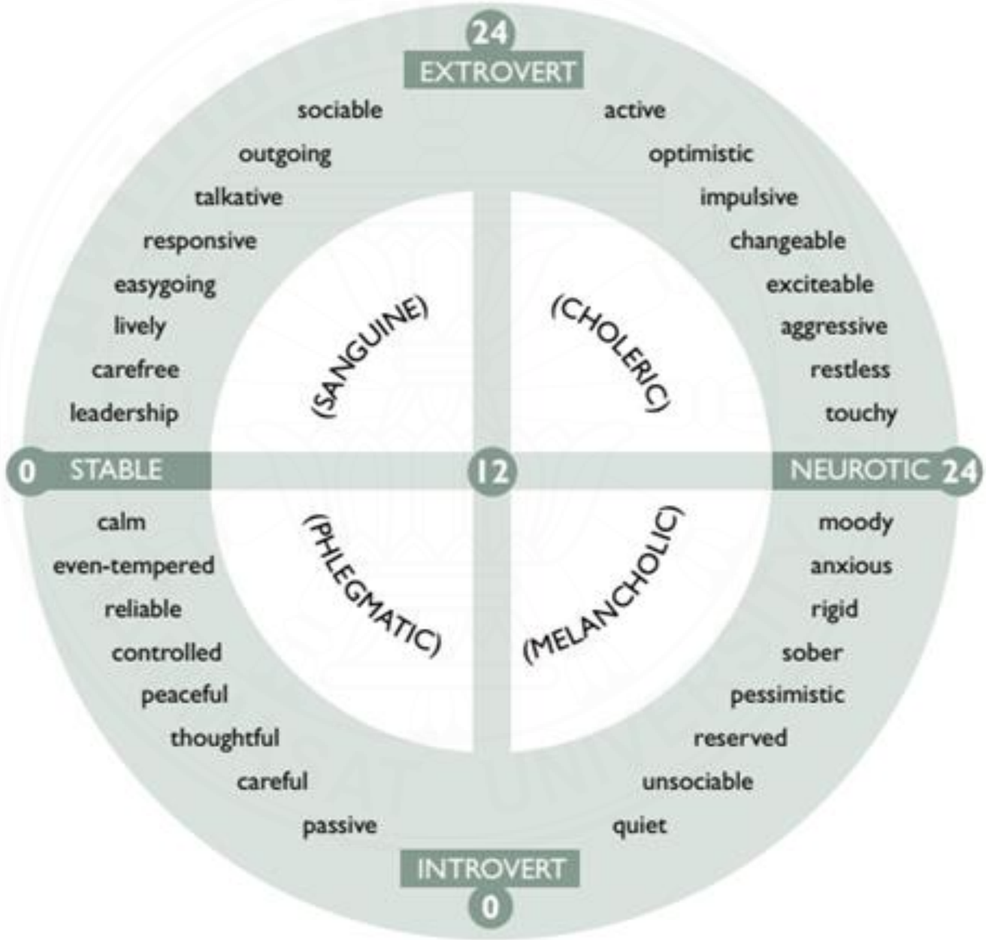

Figure 2.1 Personality measurement scale of Eysenck's Personality Inventory (EPI).

2.6.1 Introversion/Extraversion

In Eysenck's conceptualization, introversion was the opposite of extroversion (75). Introversion was moderately associated with depressive symptoms in the general urban population (76). Responsibility was a trait that leans somewhat towards introversion, likely to be serious-minded, reliable, trustworthy, and conscientious. Extroverted manners as perhaps socially irresponsible, careless, and unpredictable were more inclined to be casual with low scores of irresponsibility. Introverted people tend to worry about finding things to talk about with other people. They prefer to have only a few special friends. Their scoring high was unsociable. Extroverted people were comfortable when meeting new people, like social functions such as dances and parties. Trait tends to seek out the company of others. The scoring high was sociability (77). Extroversion was positively related to contextual performance but correlated negatively with depression symptoms (76, 78). Extroverted nurses acknowledged patients' satisfaction. They were zealous about performance to improve at the workplace (79). The level of job satisfaction of introverted individual bank employees is lower than extroverted ones (80). Occupational accident has a negative and significant correlation with extroversion (81).

2.6.2 Stability/Neuroticism

The corresponding opposite of stability was neuroticism in Eysenck's terminology (75). Neuroticism correlated strongly associated with depression and anxiety symptoms. Neuroticism was significantly associated with Beck Depression Inventory (BDI) scores and Beck Anxiety Inventory (BAI) scores (9, 76). Uneasiness, helplessness, nervousness, and fearfulness were explained as neurotic personality traits that were an unhappy and comfortless life. High neurotic personality nurse was less likely to gain patient satisfaction (79). Define items as neuroticism referred to self-consciousness, vulnerability, hostility, worry, anxiety, sadness, anger, and irritability (82). Someone high in neuroticism would be much more unstable, prone to overreacting to stimuli, and might be quick to anger, worry, or fear that respond quickly to stress (74). Physical health problems linked to neuroticism led to experiencing less social support and more stressors. Neuroticism was associated with Irritable bowel

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syndrome (82). Therefore, low extraversion and high neuroticism were related to anxiety and depression (9). An occupational has a significant positive correlation with neuroticism (81).

2.7 Indoor Air Quality

SBS symptoms had been concerned for the relationship with IAQ among employees in the offices (83). The indoor air quality parameters addressed were air movement, temperature, relative humidity (RH), carbon dioxide CO_2, carbon monoxide (CO), formaldehyde (CH_2O), ozone (O_3), and volatile organic chemicals (VOCs). Usually, several factors were the cause of SBS that work in combination and build up a point that people within the area started to be physically affected. The quality and effectiveness of the internal ventilation system were related to the SBS main cause (20, 33).

Sources of employee complaints were indoor contaminants from sources inside the building such as paints, adhesives and glues, carpeting, upholstery, manufactured wood products, off-gassing of construction material and building fabric, signature machines, blueprint copiers, copy machines, tobacco smoke, pesticides, air fresheners, positive or negative pressure work areas, cleaning compounds and disinfectants, contaminants generated by construction or renovation (29, 46, 48, 84).

Sick building syndrome was related to the indoor environment sometimes. IAQ involved SBS symptoms, such as fatigue, headache, skin, eye, nausea, cough, dizziness, sneeze, itchy, and upper airway irritation (2, 56, 85). In the workplace, healthy occupants could improve IAQ (86).

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2.7.1 Indoor Air Quality Parameters

2.7.1.1 Physical parameters

(1) Temperature (T)

Temperature, humidity, and air movement were the factors hygrothermal related to the thermal comfort and dryness of SBS symptoms of building occupants, but also the rate of pollutants emitted and deposited from people and materials in the buildings. Therefore, hygrothermal be considered as determinants of IAQ (1). A greater effect on staff, too hot or too cold IAQ might cause a physical reaction for occupants. The extreme temperature might be more susceptible, further distress the human body (20). Temperatures above 32°C in the working area could be considered a high-temperature environment (87). Off-gassing from materials increased with higher temperatures (24). SBS symptoms and temperature reported a link between higher intensity or higher prevalence of SBS symptoms and warmer temperatures (88).

Field studies showed temperatures above 21°C increased SBS symptoms (18). SBS was related to room temperature. In the temperate climate, general mucosal irritation symptoms such as tiredness and headache may occur at temperatures above 22-23°C. There was high tolerance for high room temperature in tropical areas (21, 25, 26). The temperature was 20-26°C with humidity of 40-60%, and the symptoms such as fatigue and headache increased while the thinking ability decreased. The temperature increased, and symptoms such as nasal congestion and sneezing increased (25).

(2) Relative humidity (RH)

Common within sealed buildings was airless conditions and dry. Sore throat and cough were both negative effects of physical and mental (22). Symptoms of SBS such as dermal, upper respiratory, and ocular symptoms were relative to air humidity. Including pain in the eyes, skin redness, and sneezing also showed a significant association with RH. Nevertheless, indirectly causing SBS, microbial growth was related to high relative humidity (6, 26). Humidity could cause SBS symptoms when it was low level or high level, cause of ocular, dermal, and upper respiratory symptoms were low air humidity, whereas too high air humidity indirectly caused symptoms because water condensation was due to microbial growth. Dust mite levels increased while humidity above 50% and spread by ventilation could cause increased allergic symptoms among those sensitive to dust mites (25, 61).

RH levels between 25% and 60% were specified by ASHRAE (89). low relative air humidity may cause an increase of symptoms compatible with the sick building syndrome. Decreasing SBS symptoms was associated with increasing humidity. Around 25% reported in some evidence (90, 91). The symptoms such as dermatitis and drying of the skin and mucous membranes could occur when RH was less than 20% (24). Relative humidity levels below 25% were associated with increased discomfort and drying of the mucous membranes and skin. It can lead to chapping and irritation (89). On the other hand, increased humidity promotes the growth of microorganisms (18). Skin and eye symptoms decreased, increasing relative humidity (RH) from 40-50% to 50-60% and significantly increased cough (6).

2.7.1.2 Chemical parameters

(1) Carbon dioxide (CO_2)

Colorless, tasteless, and odorless gas is carbon dioxide (CO_2) produced naturally in the environment through human activities like burning oil, gasoline, wood, and coal. The CO_2 level increases by individual exhale respiration (48). Ordinary CO_2 concentration outdoor is 325-350 ppm. Building ventilation can be measured by either CO_2 levels, personal outdoor air flow, or air exchange rate. The level of CO_2 should be below 1000 ppm. Usually, stale and stuffy air could cause discomfort when indoor levels were high, owing to a rise of around 1,000 ppm was likely to human respiration (26, 30). An increased percentage of dissatisfied occupants was associated with a CO_2 concentration higher than 0.1% (24).

CO_2 is one of the inorganic substances found in the contaminated air (92). The lower respiratory syndrome was SBS positively associated with increasing the level of CO_2. One of the factors influencing the high level of CO_2 in the old building was the mechanical floor mechanism (22). Higher occupant density in buildings CO_2 indicates a problem with overcrowding or inadequate outdoor air ventilation rates (48). A by-product of normal cell function was CO_2 which was removed from the body via the lungs in the exhaled air. High levels of CO_2 were referred to as hypercapnia or hypercarbia. More symptoms ranging from headache to unconsciousness appear, and it could also lead to death by the increasing severity of hypercapnia (48).

Exposure to CO_2 was associated with SBS symptoms. It may cause headache, malaise, fatigue, dizziness, nausea, dyspnea, nasal irritation, eye symptoms, throat dryness, wheeze, and respiratory tract symptoms. When CO_2 concentrations rise, SBS symptoms like headaches and fatigue appear (6, 42). Acute health effects increase respiration rate, drowsiness, and difficulty concentrating (43).

(2) Carbon monoxide (CO)

Carbon monoxide (CO) is a colourless, odourless, tasteless gas. It is a product of incomplete fuel combustion, including tobacco. Natural gas, propane, and gasoline produce larger CO quantities reducing blood oxygen-carrying capacity (30, 43, 93-95). Vehicle exhaust is a major source of carbon monoxide. If the air can intake the building, indoor CO concentration may increase (24, 33, 48, 96).

CO could build up unknowingly to hazardous rates. Humans could not detect CO through the smell or sight of the naked eye. Pregnant people and heavy smokers who suffer from heart & respiratory diseases would be most affected by the presence of CO (96).

CO levels need to be maintained as a time-weighted average (TWA) concentration below 25 parts per million (ppm) and must not exceed 100 ppm short-term exposure (94). Designed to protect nonsmokers from CO contained in ETS, a guideline concentration of 10 mg/m^3 (8 hours averaging time) had introduced by the World Health Organization and USEPA's National Ambient Air Quality Standard (WHO 1987) (24, 30, 96).

Sick building syndrome symptoms such as headache, fatigue, and dizziness were significantly associated with the CO concentration above 10 ppm (25). Mild headaches, nausea, and shortness of breath were symptoms of low level CO poisoning. Occupants feel better when they expose to the fresh air outside. The high

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CO concentration and prolonged exposure could be causes of brain damage and even death (48, 95).

(3) Ozone (O_3)

Ozone (O_3), common names or synonyms are triatomic oxygen and trioxygen. It is a colorless gas consisting of three oxygen atoms, a component of photochemical smog. O_3 formed in the lower atmosphere, and the sunlight chemical of VOCs reacts with nitrogen oxides. The upper atmosphere, where O_3 also occurs naturally, shields the earth from harmful ultraviolet. O_3 is a toxic gas with a peculiar odor. It is used in industry as an oxidizing agent to kill bacteria and algae (30, 84, 86, 94, 97).

Ultraviolet radiation produces O_3 from oxygen, naturally present in the air, emitted from electrical equipment such as electrostatic precipitator devices used to clean the air by removing dust, photocopying machines, electrical arcing, and laser printers (especially when not properly maintained), and produced by electrical discharge O_3. It was an irritant to the respiratory tract. High O_3 concentrations could be close to these sources (24, 33, 43, 98). The eight-hour exposure limit is 0.1 ppm. Eye, nose, and throat irritation were at this level since high voltage equipment, laser printers, and photocopiers in the building released O_3 (30). O_3 exposure was eyes, skin, and inhalation. The effects of acute exposure: eye, respiratory tract, mucous membrane irritation, headache, discomfort, dry throat, coughing, heavy feeling in the chest, shortness of breath, irritation of eyes or skin were also possible, and aggravation of chronic respiratory diseases (43, 97).

(4) Formaldehyde (CH_2O, HCHO, H_2CO)

Formaldehyde (CH_2O, HCHO, H_2CO) has been intensively studied as a highly volatile organic molecule since it was released in the construction (VVOC). Consumer products and low vapor pressure have relatively semi-volatile organic compounds (SVOCs). CH_2O is a common indoor pollutant, pungent odor, and colorless gas released from many naturally occurring products, including adhesives. Therefore, it reached occupants by building and consuming (27, 33, 93).

Emissions of formaldehyde are a significant indoor issue. Levels of CH_2O increase in high temperature by many sources of emission found in hundreds of different products such as insulation material, particle board, office furniture, ceiling tiles, floor finishes, plywood, carpet glues, upholstery, synthetic fibers in rugs, other textiles, and paper such as bulk paper stores, sanitary paper production, pesticides, paint, adhesives, varnishes, various plastics, disinfectants, cleaning agents, cosmetics such as shampoos, liquid soaps, nail hardeners, and nail varnishes, electronic equipment such as computers and photocopiers, and other household products emit CH_2O. Wanner et al. reported high concentrations of CH_2O in new buildings where insulating materials releasing CH_2O related to pharyngeal or ocular irritation and discomfort symptoms (24-27, 30, 33, 43, 93, 96, 99). The products were classified according to the rate of emission of CH_2O. There were three classes E3, E2, and E1. Products with the E1 rating emit the least formaldehyde (test values equivalent to 0.1 ppm equilibrium level) (30).

The WHO guidelines for IAQ, this pollutant had been addressed in 2010, using sensory irritation was as a critical outcome (WHO 2010b), and since 2012, CH_2O was classified as carcinogenic group 1 by the International Agency for Research on Cancer (IARC) (100). SBS symptoms shown correlate with indoor concentrations of CH_2O. It could irritate the lower or upper respiratory tract and eyes. It was a cause of sick building syndrome. It could be an irritant that causes dizziness, headaches, skin rashes, and memory loss when exposed to higher quantities. There were significant increases in symptoms of irritation that the threshold of irritation started at levels above 0.3 mg/m^3 in healthy subjects. The concentration limit of 0.1 mg/m^3 of indoor air has been introduced by WHO (WHO 1987) (24, 25, 27, 30, 43, 69, 99, 101). Expose CH_2O levels of 0.36 mg/m^3 for four hours was the lowest concentration that causes sensory irritation of the eyes in humans. CH_2O 0.6 mg/m^3 might increase conjunctiva redness and eye blink frequency, and nose symptoms occur at 0.63 mg/m^3 with peaks up to 1.25 mg/m^3. Thus, preventing sensory irritation in the general 0.1 mg/m^3 in 30 minutes population was recommended as a short-term guideline (96).

(5) Volatile Organic Compounds (VOCs)

VOCs are organic molecules made of carbon with a high vapour content, little water solubility, and consequently evaporate at room temperature inside a structure. These variety of indoor sources including photocopiers, printers, and cleaning products (20). VOCs were many substances, including acrolein, alcohols, benzene, methacrylate, methyl ethyl ketone, polycyclic aromatic hydrocarbons, toluene, trichloroethylene, and pesticides (43).

Sources of VOCs in indoor environments were products of personal hygiene (cosmetics), constructional products, household products (waxes, detergent, insecticides), furniture, do-it-yourself goods (resins), office material, and equipment (27, 47). The primary cause of SBS was VOCs. The type of activity, the space, and the time all had an impact on the levels of VOCs (27). In new buildings, the level of VOCs was higher than in older buildings (1). In the Danish Townhall study, the effect of VOCs dissolution was speculated in the water adsorbed on material surfaces, particularly papers and books on open shelves and surfaces with high adsorption rates (fabrics, carpets, etc.). The number of such surfaces in rooms referred to as fleece and shelf factors correlated strongly with the complaint rate (24).

There were many possible sources of VOCs such as adhesives, air fresheners, asphalt, cleaning compounds, combustion products, cosmetics, disinfectants, dry cleaned clothing, dyes, fuels, furnishing, gasoline vapors, glues, dried out floor drains, herbicides, insecticides, lubricants, mothballs, paints, perfumes, pesticides, photocopiers, plastics, polishes, printers, signature machines, silicone caulking materials, spray repellents, "spirit" duplicators, sealants, solvents, stains, tobacco smoke, varnishes, waxes, wood preservatives, and other personal products (20, 25, 26, 41, 43, 48, 56, 58, 62, 89, 93, 102-106).

VOCs indoor sources were causes ranging from fatigue to shortness of breath and headache, damage to the human body in various ways, such as cleaning supplies, printers, and photocopiers (20). VOCs sources might be causing lower respiratory irritation and mucous membrane directly by producing irritants (107). VOCs health effects were dizziness, eye, fatigue, headache, nose, nausea, neuropsychological dysfunction, throat irritations, respiratory tract, and mucous membrane irritation (11, 43, 62).

(6) Particulates

Particulate air pollution is any liquid or solids suspended in the air. It includes fumes, soot, smoke, and other combustion byproducts, but natural particles such as sea salt, windblown dust, spores, and pollen. Particulate air pollution is a mixture of contaminants from a range of sources. Exhaust tailpipes and stacks that are primary particles. Secondary particles such as nitrates and sulfates are the byproducts of the oxidation of gases or the condensation of vaporized materials in the atmosphere (108).

A particulate source in the building is air inlets, carpeting, cigarette smoke, combustion, concrete, construction, cooking fumes, curtains, deterioration of materials, duct insulation, fabric, furnishing, gypsum boards, HVAC filters, housekeeping, incomplete combustion, materials, renovation, outdoor sources, paper, printing, vacuuming, vehicular exhaust (51, 88, 89, 103). Symptoms in some studies associated with fibrous dust are a major contributor to the paper (91).

A cause of SBS symptoms was particles that were from indoor mold contamination. Other soft fiber wall materials and textiles were possible determinants of SBS. Particles bound in wall-to-wall carpeting that was a fleecy material that could be released, for example, vacuum cleaning (56). Building particles contributed to sick building syndrome probably in a non-specific manner. An association between macromolecular dust and symptoms shows multi-building in Copenhagen town hall (91).

The physical makeup and size of particulates are related to health effects penetration into the respiratory tract. Fine particulates less than 5μm were most sensitive and entered the deepest parts of the lung, where CO_2 is exchanged with oxygen from the blood. The particles 5μm-10μm deposit near the fine airways caught in the mucus. The upper part of the lung is deposited particles above 10μm trapped by fine hairs in the trachea (30). UFP is released when the photocopier has activity. Although there was a photocopy room, the door was opened from time to time during the photocopy activity. Then UFP level was still high. The size of the UFP was smaller than PM10 and PM2.5, so the toxicity effect was greater than PM10 and PM2.5 since it could go the narrower area (52). Large particles irritated the upper respiratory tract, skin, eyes, and sensations of dryness (91). Smaller particles caused lung-related problems: emphysema (airway obstruction), asthma, bronchitis, acute febrile illnesses (humidifier fever, organic dust toxic syndrome), ,allergic reactions (allergic alveolitis), causing reduced lung compliance, fibrotic reactions, and impairment of gas exchange (asbestosis, pneumoconiosis); lung cancers (30).

There were several studies on particles and carpets in offices. One intervention study comprehensive, cleaning reduced airborne dust and decreased mucosal symptoms that the effect of cleaning reducing airborne dust. In another study, office workers reported the relationship between mucosal symptoms and textile wall materials (56). There were associations between symptoms and dust (gram-negative bacteria dust, particulates, macromolecular dust, and volatile organics desorbed from the dust) (91).

2.7.1.3 Biological parameters

Biological factors are microorganisms (viruses, mould, bacteria, and microscopic parasites), cell cultures, human endoparasites, and components from microorganisms that can cause damage to health in humans (109). Biological parameters, mould, and bacteria are the etiology of SBS.

(1) Mould

Microbials are viruses, fungi, mould, bacteria, nematodes, amoeba, pollen, dander, and mites. Excessive concentrations might result from housekeeping, inadequate maintenance, condensation, inadequate humidity control, water spills, or water intrusion through leaks in the building envelope or flooding (44, 57). Humidifiers were a source of both moisture and nutrition that mould and bacteria concentrations were likely to increase in buildings (30).

Sources of microbial are air handling system condensate, animals, animal excreta, bird droppings, cockroaches, cooling towers, damp, dust mites on upholstered furniture, food, food products, high humidity indoor areas, hot water

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systems, humidifiers, insects, organic material, outdoor excavations, plants, porous wet surfaces, rodents, water-damaged materials (43, 103).

Mould was a number observed or reported an association between SBS increasing and indoor mold and building dampness (27). In Japan, a study on newly built dwellings related SBS symptoms and dampness. SBS symptoms increased related to building dampness in Swedish multi-family residential buildings (56). Rainwater ingress, such as a roof or drainage system leak, can rapidly lead to mold growth problems. An insidious and undiscovered roof leak could cause some instances of problems. The paper covering timber and gypsum plasterboards are used in construction, etc. Mould could utilize cellulose or starch in wallpaper paste. Mold colonization was fabrics and wooden furnishings. Localized damp areas can occur in the space between a wall and a large item of furniture such as a cupboard. Accelerated mould growth may result from water damage or poor maintenance of buildings (110).

Indoor airborne fungal spores could cause sick building syndrome (111). Health effects symptoms were chest tightness, chills, cough, diarrhea, fever, headache, muscle ache, nausea, and sore throat (43). The general SBS symptoms were mucosal symptoms and skin symptoms by perceived mouldy odour after adjusted odds ratio (27). Therefore, health complaints such as fatigue, cough, and headaches might occur when indoor mould levels exceed 500 cfu/m^3 (110).

(2) Bacteria

One of the biological risk factors of SBS contaminants in indoor air is bacteria. Humidifiers are a source of moisture and nutrition that bacteria might increase in buildings. When indoor building sufficient moisture is available, microbial pollution involves hundreds of species of them and grows in that area (30, 112).

Bacteria grow up at 36°C. Ventilation system type with an average concentration of 200, 233, and 678 cfu/m^3 related to naturally ventilated, mechanically ventilated, and fully air-conditioned buildings. Results of bacteria reports were similar to those reported for mold. The result was relatively few differences in indoor viable bacterial levels in different building ventilation types in the California Healthy Building study (112).

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Associations were found between the indoor total bacterial count (TBC) and other building factors (wall painting, last floor covering, renovation times, cooking fuels, heating, and the age of the building). Indoor TBC levels together with personal factors (gender and daily time spent indoors) and the building-related factors (amount of carpet covering, occupancy rate, heating fuel, environmental tobacco smoke (ETS) exposure, distance to traffic, and last wall painting time) were found to be associated with SBS symptoms (60). The fully air-conditioned buildings with the lowest bacteria levels had the highest prevalence rate of SBS symptoms. In naturally ventilated buildings, the lowest prevalence rate of SBS symptoms was discovered at the highest levels (112).

Gram-positive species of Streptococcus, Staphylococcus, and Micrococcus were generally predominant bacteria in indoor air which emanate from the skin, mouth, nose, and nasopharynx. There was an abundant source of water, drain pan, and saturated surfaces which gram-negative bacteria might occasionally be there (88). Allergies, asthma, immunological reactions, and respiratory symptoms were associated with exposure to microbial contaminants. Tiredness, hoarseness, itchy eyes, cough, and breathing of the nose relationship with bacteria endotoxins by evaluating the potential studies of Rylander et al. (112). Participants often observed general SBS symptoms (headache, fatigue, and dizziness) in females (60).

2.7.2 Indoor Air Quality Sampling

IAQ sampling should be selected suitable location. The number of sampling was calculated by the size of each area.

2.7.2.1 Sample size of sampling

The number of sampling points for indoor air quality assessment, Industry Code Practice on Indoor Air Quality 2010 by Department of Occupational Safety and Health Ministry of Human Resources, Malaysia recommended the minimum number of sampling points for IAQ assessment presented in Table 2.3 (113-115).

Table 2.3 Minimum number of sampling points for indoor air quality assessment.

Building area (m^2)	Minimum number of sampling points
< 3,000	1 per 500 m^2
3,000 - < 5,000	8
5,000 - < 10,000	12
10,000 - < 15,000	15
15,000 - < 20,000	18
20,000 - < 30,000	21
≥ 30,000	25

Note. Engineering Services Division, Ministry of Health Malaysia. Guideline on indoor air quality for hospital support service. Sustainability Programme. 2015.

2.7.2.2 Sampling Location and Position (22, 113-115).

1. Passageways or hallways should reject and escapes junction connected to stations of public transport facilities.

2. The location should be the occupant density area, representing the primary workstation and work activities.

3. The area was complained occurrence, problem or contaminant source recording, possibly contaminated highest concentration.

4. Work activities should be minimal disturbances and will not be obstructed or interfere with a normal or emergency.

5. The fresh air intake that is not accessible should be considered representative locations. Approximately 1 meter off the edge of the fresh air monitor in the inlet location, away from directly in front of the exhaled breath of the operator, heaters, induction units, floor fans, air supply diffusers, etc.

6. Take the instrument away from the location impacted by direct moisture and sunlight, enclose and intake the shield in an appropriate shelter.

7. The sampling position should be the distance from walls, windows, partitions, and corners at least 0.5 meters, not within 3 meters around an elevator corridor or lobby, from 2 meters of the door.

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8. The monitoring position height is between 75 and 120 cm, preferably 110 cm from the floor, at least 1-meter distance from localized sources such as printers, photocopiers, etc.

2.7.2.3 Sampling Period

The Short Term Exposure Limit (STEL) should measure for investigating acute effects for 15 minutes (28, 94, 116). The time of sampling in offices is two working hours (116). Half an hour for four time-slots of measurement is the surrogate measurement (114, 115). Some chemical levels peak in the middle of the day after increasing in the morning, dropping off after lunch (117).

2.7.2.4 Sampling Equipment

Sampling equipment is the direct reading instrument for portable indoor air quality monitoring and collecting microbial air samples.

(1) Portable Indoor Air Quality Monitor

Q-Trak® model 7575 with Model 982 IAQ Probe is the instrument for measurement 4 parameters.

- Temperature (T)
- Relative humidity (RH)
- Carbon dioxide (CO_2)
- Carbon monoxide (CO)

Q-Trak® model 7575 with Model 985 IAQ Probe is the instrument to measure Volatile Organic Compounds (TVOCs).

Aeroqual Series 500 Monitor® (S-500) with O_3 Sensor Head is the instrument to measure Ozone (O_3).

Aeroqual Series 500 Monitor® (S-500) with CH_2O Sensor Head is the instrument to measure Formaldehyde (CH_2O, HCHO, H_2CO).

Met One Aerocet -531S® is the instrument to measure Particles PM 2.5 and PM 10.

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(2) Microbial Air Sampler

SAS Super ISO 100® is the instrument that collects 2 parameters of air samples.

- Mould
- Bacteria

2.7.2.5 Sampling Methods

(1) Pt100

A type resistive temperature detector (RTD) is a Pt100 sensor or probe as a function of temperature that will change its resistance. The resistance probe calculated the temperature (117-119).

(2) Thin Film Capacitive

Commonly calibrated in RH terms, the moisture sensor of capacitive thin-film responds to relative change (118, 119). Two conductive electrodes are the ceramic substrate on which a thin polymer film is capacitive RH sensors. Micro porous metal electrodes coated the sensing surface to protect from exposure to condensation and contamination while allowing the polymer to absorb moisture (120).

(3) Non-dispersive Infrared (NDIR)

CO_2 is a readily available gas for detectors, and now very commonly used in portable gas monitors is NDIR equipment. It is a relatively inexpensive way to keep workers safe, rugged, and easy to calibrate (121). NDIR sensor is the real-time measurement of CO_2. An infrared source (lamp), a light tube or sample chamber, and a wavelength sample chamber are the main components, and its absorption of a specific wavelength in the infrared (IR) measures electrooptically CO_2 concentration (122).

(4) Electrochemical

On an electrochemical gas sensor surface, the detected molecules undergo a redox reaction on a suitable electrode, generating an electrical current depending on the gas concentration. The sensing surface of the sensitive layer plays the role of a receptor. A transducer is connected to the receptor. An electrical measurer is a response device that transforms the atomic-scale interaction (123). The

Ref. code: 25655817320061KEF

principles of voltammetry or coulometry affect the measurement utilized to employ cells of electrochemical-based detection instruments. The electrochemical monitors are usually microprocessor controlled, stable, and easy to calibrate (124).

Inexpensive and perform adequately in less-demanding are two-electrode sensors. The dominant designs for industrial applications are the three-electrode. The third electrode is the potential between the working electrodes and the counter. Detecting toxic gases in the electrochemical sensors are generally used three-electrode sensors. A more performance auxiliary sensor allows the simultaneous measurement of two gases by the fourth- electrode (123, 124).

- The carbon monoxide (CO) sensor is a three-electrode sensor. Any interference with other acidic gases is removed by equipping an inboard filter. There are four electrodes in the optional high range CO sensor. The carbon monoxide gas concentration is one measurement, and the hydrogen compensated concentration is interfering gas (125).

- Ozone (O_3) sensor, three electrodes respond to O_3. An electrochemical ozone sensor is new sensing composite material that is strong and stable in response to O_3. O_3 instrument sensors with characteristics of velocity and concentration are used (125, 126).

- Formaldehyde (CH_2O) sensor, three electrodes respond to formaldehyde. Removing any interference from other acidic gases is equipped with an inboard filter (125).

(5) Photoionization detector (PID)

A photoionization detector (PID) is a direct-reading instrument for Volatile Organic Compounds concentration measurement (VOCs) (102). Concentrations in parts per billion (ppb) and parts per million (PPM) of gases indoor air have been measured by PID (125). The PID has been used successfully in complex mixtures of chemical analysis to segregate aromatic compounds from aliphatic compounds (104).

Ref. code: 25655817320061KEF

Ionization potentials fall selection within certain boundaries that chemical analysis for compounds. It is continuously irradiated with high-energy ultraviolet light within the column effluent, exits the analytical column, and enters the PID's reaction chamber. Correspond to specific energies measured in electron volts after specialized lamps emit ultraviolet light at discrete wavelengths. Compounds will produce ions if the ionization potentials of compounds are below this energy level, and these ions will be collected, measured, and recorded (104).

(6) Scattered laser light (photometer)

The light scattering (photometer) is a direct-reading dust monitor method. A laser or solid-state diode is a collimated light source that illuminates dust entering and the airborne dust proportion to the respirable fraction. Concentration is the intensity of light scattered in the forward direction. Integrating photometry, particle counting methods, and light scattering dust determines airborne dust health-related percentages the occupational and environmental (127).

(7) Spin Air

Spin Air® is used for microbial air contamination monitoring and pulls a measured amount of air over the agar plate. An important feature is making colonies easier to count. The process ensures the maximum microorganism distribution of the rotation plate throughout the entire plate surface (128, 129).

Air sampling was collected air for 250 liters by Spin Air for 3 minutes. Mould is cultured on 2% Malt Extract Agar (MEA) and incubated at 25°C for five days. Bacteria is cultured on Tryptone Soya Agar (TSA) media and incubated at 35°C for 48 hours (88, 130, 131).

2.7.3 Indoor Air Quality Guidelines

There are Indoor Air Quality Guidelines in Asia, for instance, Singapore and Malaysia. There are 2 standards in Thailand, the Department of Health Thailand (draft) and the Department of Health, Thailand (Bangkok draft). IAQ compared in Table 2.4 (88, 115, 132).

Table 2.4 Indoor Air Quality Guidelines.

IAQ Parameters	Acceptable limit 8 hours			
	SINGAPORE STANDARD SS : 2009[a]	INDOOR AIR QUALITY 2010, Malaysia[b]	Department of Health, Thailand (draft)[c]	Department of Health, Thailand (Bangkok draft)[c]
Temperature (T)	24-26 °C	23-26 °C	24-26 °C	22.5-25 °C
Relative humidity (RH)	< 65% (for new building), < 70 % (for existing building) (under peak and common part load conditions)	40-70 %	50-65 %	70 %
Carbon dioxide (CO_2)	700 ppm over outdoor	1,000 ppm	1,000 ppm	1,000 ppm
Carbon monoxide (CO)	9 ppm	10 ppm	9 ppm	9 ppm
Ozone (O_3)	0.1 ppm	0.05 ppm	0.1 ppm	0.05 ppm
Formaldehyde (CH_2O)	0.1 ppm	0.1 ppm	0.1 ppm	0.1 ppm
	120 mg/m^3		120 mg/m^3	
Volatile Organic Compounds (TVOCs)	3 ppm	3 ppm	3 ppm	3 ppm
Particles (PM 2.5)	35 mg/m^3	-	35 mg/m^3	-
Particles (PM 10)	50 mg/m^3	0.15 mg/m^3	50 mg/m^3	150 mg/m^3
Mold or Mould	Up to 500 cfu/m^3 is acceptable, if the species present are primarily Cladosporium	1000* cfu/m^3	500 cfu/m^3	500 cfu/m^3
Bacteria	500 cfu/m^3	500* cfu/m^3	500 cfu/m^3	500 cfu/m^3

[a]Spring Singapore Enabling Enterprise. Code of practice for indoor air quality for air-conditioned buildings. Singapore Standard. 2009.

[b]Department of Occupational Safety and Health Ministry of Human Resources, Malaysia. Industry code of practice on indoor air quality. 2010.

[c]Department of Health. Ministry of Public Health. A guide to audit practice indoor air quality (Bangkok draft). 2016.

CHAPTER 3
RESEARCH METHODOLOGY

This cross-sectional study of 165 workers from eighteen rooms was performed in a back office using split air conditioners. Participants were full time employees who do not provide onsite services. They spent most of their time in the office.

Each room measured 10 parameters of indoor air quality; temperature, relative humidity, carbon dioxide, carbon monoxide, ozone, formaldehyde, volatile organic compounds, particulates (PM2.5, PM10), mold, and bacteria.

3.1 Method

The eighteen split-type back office rooms were selected from seventeen departments. Seventeen departments included Nursing, Policy and Planning, Finance, Accounting, Internal Audit, Quality Service Development, Human Resource, Health Insurance, Inventory Procurement, Fabric Service, Maintenance, Health Promotion, Registration and Warehouse, Equipment Warehouse, Contract Management, Medical Supplies Warehouse, and Nutrition.

3.1.1 Population

The population was back office workers who had been working for least three months and spent most of their working hours in their offices. The back office workers who had been working for less than three months or sometimes worked outside their rooms were excluded.

Ref. code: 25655817320061KEF

3.1.2 The sample size of participants

The study population was 175 workers. The sample size of workers was calculated by the formula below (133).

$$n = \frac{NZ^2_{\alpha/2}\, p\, (1-p)}{d^2\, (N-1) + Z^2_{\alpha/2}\, p\, (1-p)}$$

n = Required sample size.

N = Population size (175).

d = Degree of accuracy (3%).

$Z^2_{\alpha/2}$ = The table value of chi-square for 1 degree of freedom at the desired confidence level (3.841).

p = Population proportion (0.41) (Romyen, 2014).

SBS prevalence in hospitals was 24.62% up to 70.80% in Thailand (13-15). Sick building syndrome prevalence is population proportion in the formula. The sample size of workers was calculated by the formula (133). The sample size of each prevalence shows in Table 3.1. The highest sample was 150 workers (41.54%). This study determined the sample size for non-response error was 10%. Therefore, the sample size was 165 workers.

Table 3.1 Sample size of the participant of each prevalence.

Sick Building Syndrome prevalence	Sample size of participant
24.62% (Tonprom, 2010)	123
41.54% (Romyen, 2014)	150
70.80% (Manmee, 2017)	142

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3.1.3 The sample size of participants each room

The sampling procedure consisted of the following two steps:

1) The sample size of each room based calculated proportionally to the number of workers in each room.

2) The workers in each room were selected by simple random sampling with a table of random numbers from a list of worker names.

The number of workers and sample size as shown in Table 3.2.

Table 3.2 The number of the study population and sample size for each room.

Item	room	No. of worker (N)	No. of sample (n)
1	Nursing	12	11
2	Policy and Planning	12	11
3	Finance	17	16
4	Accounting	17	16
5	Internal Audit	8	8
6	Quality Service Development	14	13
7	Human Resource 1	11	10
8	Human Resource2	7	7
9	Inventory Procurement	6	6
10	Fabric Service	5	5
11	Maintenance	2	2
12	Health Promotion	12	11
13	Equipment Warehouse	9	8
14	Contract Management	4	4
15	Registration and Warehouse	10	9
16	Medical Supplies Warehouse	22	21
17	Nutrition	3	3
18	Health insurance	4	4
Total		175	165

3.1.4 Questionnaires

The two questionnaires collected independent variables and dependent variables. This study collected data from the "Work sensation and Sick Building Syndrome symptoms questionnaire" and "Personality type questionnaire".

The work sensation and SBS symptom questionnaire was translated into Thai, including occupational characteristics, work conditions, psychosocial factors, and 5 SBS symptom groups. The Eysenck's Personality Inventory (EPI) questionnaire was translated into Thai. It classified the participants into personality types, introvert, extrovert, stable, and neurotic. Detail of variables in each questionnaire shows in Table 3.3.

Table 3.3 The detail of the variables included in each questionnaire.

Questionnaire	Independent variables	Dependent variables
1. Work sensation and Sick Building Syndrome symptoms	- Occupant characteristics: gender, age, and allergy history. - Work conditions: work-related equipment, working hours/week, and absent days. - Psychosocial factors: job stress, job satisfaction, and social support.	-SBS symptoms: eyes, nose, throat, skin, and neurotic system.
2. Personality type	- Personality type: introvert, extrovert, stable, and neurotic.	-

3.1.4.1 Work sensation and Sick Building Syndrome symptoms questionnaire

The Work sensation and Sick Building Syndrome symptoms questionnaire objective was to collect data on occupant characteristics, work conditions, and psychosocial factors. These data have analyzed the prevalence of sick building syndrome among back-office workers. This questionnaire was separated into 3 parts.

Part 1 General information (occupant characteristics and work conditions)

1.1 Occupant characteristics consisted of 3 questions, including gender, age, and allergy history.

1.2 Work conditions consisted of 3 questions, including work related equipment, working hours/week, and absent days.

Part 2 Work situation (psychosocial factors)

2.1 This part consisted of the 15 items that included job stress questions. Job stress was defined as the responsibility of not being matched to knowledge and abilities, challenging the ability to cope and interact with the supervisor (134-136). The job stress questionnaire was modified from five questionnaires (134-138). Scoring was a Likert Scale 5-point scale ranging from “Never” on one end to “Always” as follows:

“Never”	= 1 point
“Seldom”	= 2 points
“Sometimes”	= 3 points
“Often”	= 4 points
“Always”	= 5 points

Fifteen items, score summed and classified into 3 levels, including low level, middle level, and high level, as shown in, as shown in Table 3.4.

2.2 This part consisted of 30 items, including job satisfaction and social support questions. Job satisfaction was related to general working conditions, salary, and promotion potential, using skills and abilities (139). The Job satisfaction questionnaire was modified from seven questionnaires (139-145). Fifteen questions were No. 1-15. Social support was an organization or colleagues support information, instrumental, and solve their problems (62). Social support questions were modified from three questionnaires (146-148). Fifteen questions were No. 16-30. Scoring of 30 items was a Likert Scale 5-point scale ranging from “Strongly Disagree” on one end to “Strongly Agree” as follows:

"Strongly Disagree" = 1 point
"Moderately Disagree" = 2 points
"Neither Agree nor Disagree" = 3 points
"Moderately Agree" = 4 points
"Strongly Agree" = 5 points

Work situation included job stress, job satisfaction, and social support. Summed and classified the score of each factor to be 3 levels low, middle, and high level (149), as shown in Table 3.4.

Table 3.4 Psychosocial factors measurement and classified level.

Psychosocial factors	Likert Scale	Score	Total Score	Score of level of Psychosocial factors		
				Low level (percentile score of 25 or lower)	middle level (percentile score of 26-74)	High level (percentile score of 75 or higher)
Job stress 15 questions	Never	1	15-75	15-30	31-60	61-75
	Seldom	2				
	Sometimes	3				
	Often	4				
	Always	5				
Job satisfaction 15 questions and Social support 15 questions	Strongly Disagree	1	15-75	15-30	31-60	61-75
	Moderately Disagree	2				
	Neither Agree nor Disagree	3				
	Moderately Agree	4				
	Strongly Agree	5				

Part 3 Symptoms experience (SBS)

This part would like to investigate the prevalence of sick building syndrome among back-office workers. This study followed the WHO indicator of SBS (18) There was 5 symptom group in this part.

(I) irritated, dry or watering eyes (sometimes described as itching, tiredness, redness, burning or difficulty wearing contact lenses).

(II) irritated, runny or blocked nose (sometimes described as congestion, nosebleeds, itchy, or stuffy nose).

(III) dry or sore throat (sometimes described as irritation, upper airway irritation, or difficulty swallowing).

(IV) dryness, itching or irritation of the skin, occasionally with a rash.

(v) less specific symptoms such as headache, lethargy, irritability, and poor concentration.

The symptom experience occurred while back office workers spent time in the workplace during working hours, and the symptoms did not appear on holiday or after they left their office or buildings. There were 5 symptom groups. The symptom of each group that had not occurred at home within 3 months recorded by the back office worker who had experienced at least 1 symptom. The frequency of symptoms classified into 2 groups, 1-3 days or ≥ 4 days per week.

3.1.4.2 Personality type questionnaire

The Eysenck's Personality Inventory (EPI) questionnaire translated into Thai version. It classified the participants into personality types, introvert, extrovert, stable, and neurotic. The personality type questionnaire divided into 4 personality types: introverted, introverted, open, stable, and neurotic.

This questionnaire consisted of 57 items. There were three scores. Extrovert score (E score) and neurotic score (N score) were out of 24, and lie score (L score) was out of 9. Scoring follows below (74).

(1) Extrovert score (E score):

For item 1, 3, 8, 10, 13, 17, 22, 25, 27, 39, 44, 46, 49, 53 and 56 each response was scored as follows:

“Yes” = 1 point

“No” = 0 point

For item 5, 15, 20, 29, 32, 34, 37, 41, and 51 each response was scored as follows:

“Yes” = 0 point

“No” = 1 point

The extrovert score was summed and interpreted, 0-12 was introvert, and 13-24 was extrovert, as shown in Table 3.5.

“Introvert” coded as 1

“Extrovert” coded as 2

(2) Neurotic score (N score):

For item 2, 4, 7, 9, 11, 14, 16, 19, 21, 23, 26, 28, 31, 33, 35, 38, 40, 43, 45, 47, 50, 52, 55 and 57 each response was scored as follows:

“Yes” = 1 point

“No” = 0 point

The neurotic score was summed and interpreted, 0-12 was stable, and 13-24 was neurotic, as shown in Table 3.5.

“Stable” coded as 1

“Neurotic” coded as 2

(3) Lie score (L score):

Lie score: for item 6, 12, 18, 24, 30, 36, 42, 48 and 54 would be excluded.

Table 3.5 Score of personality type questionnaire and personality type.

Extrovert score		Neurotic score	
Score	personality type	Score	personality type
1-12	Introvert	1-12	Stable
13-24	Extrovert	13-24	Neurotic

3.1.5 Validity and reliability testing, and ethic approval

The questionnaires were translated from English version to Thai version. Before data collection, the questionnaires were first submitted to the committee for the validity examination of content and language. The content validity of questions conducted by 3 experts, 1) Prof. M.D., Dr. Surasak Buranatrevedh, and 2) Assoc. Prof. Saravudh Sutummasa, and 3) Assoc. Prof. Dr. Sompoch Ratioran to review, edit and double-check the questionnaire to ensure the validity of the initial and translation of the questionnaire. Index of Item-Objective Congruence (IOC), the items that had scored lower than 0.5 were revised. On the other hand, which items had scores higher than or equal to 0.5 were reserved. Both questionnaires were accepted every item that IOC score was 0.67 – 1.

Ethicals has approved (No.017/2563) research ethics by The Human Research Ethics Committee of Thammasat University (Science), Thailand.

The two Thai version questionnaires' reliability of the study testing at the study site was performed by 30 workers in back-office divisions. The reliability or scale internal consistency was evaluated and calculated Cronbach's alpha by SPSS. The acceptable value for each item was ≥ 0.7.

3.1.6 Data collection

The self-administered questionnaires, the Work sensation and Sick Building Syndrome symptoms questionnaire, and the Personality type questionnaire were distributed to the participants during the investigator's visit to the participants' office for IAQ monitoring. Before signing the informed consent form, participants were informed by the participant information sheet. All participants returned both questionnaires 1 week later.

3.2 Indoor air quality assessment.

Assessment of indoor air quality (IAQ) in 18 rooms compared with SINGAPORE STANDARD SS: 2009 (88). IAQ parameters included temperature, relative humidity, carbon dioxide, carbon monoxide, ozone, formaldehyde, volatile organic compounds, particulates (PM2.5, PM10), mold, and bacteria.

3.2.1 Sample size of indoor air sampling of Indoor Air Quality

The indoor air sample was calculated based on the size of each room. The size of each room was less than 3,000 m^2, calculated 1 point per 500 m^2. The assessment is present in Table 3.6 (113). Table 3.7 presents the sampling number of each room calculated by 1 point per 500 m^2.

Table 3.6 Minimum number of sampling points for indoor air quality assessment.

Building area (m^2)	Minimum number of sampling points
< 3,000	1 per 500 m^2
3,000 - < 5,000	8
5,000 - < 10,000	12
10,000 - < 15,000	15
15,000 - < 20,000	18
20,000 - < 30,000	21
≥ 30,000	1 per 1,200 m^2

Note. Engineering Services Division, Ministry of Health Malaysia. Guideline on indoor air quality for hospital support service. Sustainability Programme. 2015.

Table 3.7 Detail of sample room size and sampling number in each room.

Item	Department	Size (m^2)	Sampling number
1	Nursing	86	1
2	Policy and Planning	72	1
3	Finance	74	1
4	Accounting	67	1
5	Internal Audit	74	1
6	Quality Service Development	92	1
7	Human Resource 1	61	1
8	Human Resource2	77	1
9	Health insurance	182	1
10	Inventory Procurement	275	1
11	Fabric Service	45	1
12	Maintenance	107	1
13	Health Promotion	41	1
14	Registration and Warehouse	156	1
15	Equipment Warehouse	28	1
16	Contract Management	57	1
17	Medical Supplies Warehouse	995	2
18	Nutrition	111	1
total			19

3.2.2 Location of sampling point

Sampling points were selected to be the representation of the majority of employees. It was not only a representative activity of the job but also does interfere with or hinder the activities of employees. Instruments are 0.5 meter away from walls, windows, partitions, at least 1 meter from office equipment such as printers, copiers, etc., and 75 and 120 centimeters away from the floor. It was directly away from the exhalation of workers.

3.2.3 Data collecting method of IAQ sampling

IAQ sampling was classified into three groups which were physical parameters, chemical parameters, and microorganism parameters. Sampling equipment supported by the Faculty of Public Health, Thammasat University, Thailand. They were calibrated annually by manufacturers. Eight IAQ parameters were recorded data, and two IAQ parameters were collected from samples at nineteen points of eighteen rooms.

3.2.3.1 Physical parameter monitoring

Physical parameters comprised temperature and relative humidity. Both parameters were measured by Q-Trak® model 7575 with Model 982 IAQ Probe (Figure 3.1)

Figure 3.1 Q-Trak® model 7575 with Model 982 IAQ Probe.

Each parameter was recorded 4 times within two hours (113). The physical parameters sampling period shows in Table 3.8. Each slot recorded data every 5 minutes for a half-hour (total of 2 hours). As a guideline for 4 time slots, the level of each parameter was calculated from the average of each slot.

Table 3.8 Physical parameters and chemical parameters sampling period.

<table>
<tr><th>IAQ parameters</th><th>Instrument</th><th>Sampling period</th></tr>
<tr><td>Temperature
(T)</td><td rowspan="4">Q-Trakm odel 7575®
with Model 982 IAQ
Probe</td><td rowspan="9">- Four times a day, each slot recorded data every 5 minutes for a half-hour.
- Two times in the morning and two times in the afternoon.
- Frist time: first point 8:30 – 9:00 a.m., second point 9:15 – 9:45 a.m.
- Second time: first point 10:30 - 11:00 am., second point 11:15 – 11:45 a.m.
- Third time: first point 13:00 – 13:30 p.m., second point 13:45 – 14:15 p.m.
- Fourth time: first point 15:00 – 15:30 p.m., second point 15:45 – 16:15 p.m.
- Concentration level of each parameter were calculated from the average of 4 times-slots.</td></tr>
<tr><td>Relative Humidity
(RH)</td></tr>
<tr><td>Carbon Dioxide
(CO_2)</td></tr>
<tr><td>Carbon Monoxide
(CO)</td></tr>
<tr><td>Ozone
(O_3)</td><td>Aeroqual Series 500 Monitor® (S-500) with O_3 Sensor Head</td></tr>
<tr><td>Formaldehyde
(CH_2O, HCHO, H_2CO)</td><td>Aeroqual Series 500 Monitor® (S-500) with CH_2O Sensor Head</td></tr>
<tr><td>Volatile Organic
Compounds
(TVOCs)</td><td>Q-Trakmodel 7575®
with Model 985 IAQ
Probe</td></tr>
<tr><td>Particles
(PM 2.5)
(PM 10)</td><td>Met One Aerocet - 531S®</td></tr>
</table>

3.2.3.2 Chemical parameter monitoring

Chemical parameters comprised six parameters, carbon dioxide, carbon monoxide, ozone, formaldehyde, volatile, and particulates.

Carbon dioxide and carbon were measured by Q-Trak model 7575 with Model 982 IAQ Probe® (Figure 3.1).

VOCs were measured by Q-Trak model 7575 with Model 985 IAQ Probe® (Figure 3.2).

Ozone and formaldehyde were measured by Aeroqual Series 500 Monitor (S-500) with Sensor Head® (Figure 3.3).

Particulates were measured by AEROCET 531S® (Figure 3.4).

The chemical parameter sampling period and instrument as shown in table 3.8, Figures 3.2, 3.3, and 3.4.

Figure 3.2 Q-Trak® model 7575 with Model 985 IAQ Probe

Figure 3.3 Aeroqual Series 500 Monitor® (S-500) with Sensor Head

Figure 3.4 Met One Aerocet -531S®

3.2.3.3 Microorganism air sampling

Mould and bacteria samples were collected by SAS Super ISO 100® (Figure 3.5). Media for culture were 2% Malt extract agar (MEA) for mould and Tryptone soya agar (TSA) for bacteria.

Figure 3.5 SAS Super ISO 100®

2% Malt Extract and Tryptone Soya Agar were sterilized by Laminar Air Flow. Media blank samples used for sample collection were not contaminated (150). The plates did not open up while preparing to sample.

Mould and bacteria samples were collected in the morning by SAS Super ISO 100®®. The air sample was 200 liters (151). Mould was cultured on 2% Malt Extract Agar. Bacteria were cultured on Tryptone Soya Agar. After sample collection, the sampling plates were immediately sealed and taken to the laboratory.

The incubation period for mould samples was 5 days at 25°C. Whereas for bacteria sample was 2 days at 35°C. Total viable and mold were counted after incubation for 18-24 hours every 24 hours, as shown in Table 3.9 (88, 115, 132). Colonies were counted and calculated for mold and bacteria using a formula based on the Super ISO 100®.

$$\text{Total count, cfu/m}^3 \text{ (colony forming unit /m}^3\text{)} = \frac{\text{Total colony} \times 10^3}{200}$$

Table 3.9 Microorganism parameters sampling method.

IAQ parameters	Instrument	Media	Method
Mold or Mould	SAS Super ISO 100®	2% Malt extract agar (MEA)	200 liters/ Incubated for 5 days at 25°C
Bacteria		Tryptone soya agar (TSA)	200 liters/ Incubated for 2 days at 35°C

3.2.4 IAQ sampling data analysis

Indoor air sampling data were compared with SINGAPORE STANDARD SS: 2009. as shown in Table 3.10. The data has interpreted the results as within the standard or not.

Table 3.10 IAQ parameters and compared with SINGAPORE STANDARD SS: 2009.

IAQ Parameters		SINGAPORE STANDARD SS : 2009
Temperature (T)		24 -26 °C
Relative humidity (RH)		< 65 % (for new builing), < 70 % (for existing builing) (under peak and common part load conditions)
Carbon dioxide (CO_2)		700 ppm over outdoor
Carbon monoxide (CO)		9 ppm
Ozone (O_3)		0.1 ppm
Formaldehyde (CH_2O)		0.1 ppm or 120 mg/m^3
Volatile Organic Compounds (TVOCs)		3 ppm
Particles	(PM 2.5)	35 mg/m^3
	Particles (PM 10)	50 mg/m^3
Mold or Mould		Up to 500 cfu/m^3 is acceptable, if the species present are primarily Cladosporium
Bacteria		500 cfu/m^3

Ref. code: 25655817320061KEF

3.3 Quality control and data management

Quality control procedures were implemented at each stage of the study to reduce measurement errors during the data collection from the questionnaire. In addition, quality control procedures were applied collection and processing of chemical, physical and biological sampling.

The IAQ samples were checked for physical parameters and chemical parameters. They were recorded 4 slots. Each slot recorded data every 5 minutes for a half-hour that covered the worst-case scenario. The biological samples were also carried out on the sealing and handling plates to laboratory.

All questionnaires were checked immediately often completed for missing items. If any incomplete questionnaires were found, then they were returned to the individual for completion.

3.4 Statistical analysis

Questionnaire data and IAQ were entered into Epidata software to be rechecked and cleaned for errors and missing values. After coding, scoring, and recording, the data was processed into SPSS software for statistical analysis.

A variety of statistical methods were used to analyze the data. All analyses were performed using SPSS software. Descriptive data described the demographic characteristics of the subjects. Categorical data present as frequency and percentages, while mean and standard deviation presents continuous variables. Inferential analysis, univariable and multivariable logistic regression analyses identified any association between independent variables (i.e., occupant characteristics, work conditions, psychosocial factors, personality types, and indoor air quality) and sick building syndrome symptoms (i.e., none, 1-3 days/week and ≥4 days/week). The binary logistic regression was used to identify factors associated with SBS. Univariable logistic regression was performed to calculate the crude odds ratio (COR) with a corresponding 95% confidence interval. The potential risk factors associated with SBS in the univariable analysis with *p*-value <0.10 or clinically relevant factors. Multivariable logistic regression was performed to calculate the adjusted odds ratio (AOR) with the corresponding 95% confidence interval. The backward selection applied with the level significance for variables to remain in the final model set at 0.05.

CHAPTER 4
RESULTS AND DISCUSSION

This Chapter presents the result of the Sick Building Syndrome in a University Hospital in Thailand. The results are presented in 9 parts as follows.

1. Sick Building Syndrome prevalence
2. Occupant characteristics data
3. Work conditions data
4. Psychosocial factors data
5. Personality types data
6. Indoor air quality data
7. Multivariate logistic regression analysis
8. Conclusion
9. Discussion

4.1 Sick Building Syndrome prevalence

SBS symptom experience has occurred while workers spent time in the workplace during working hours. They diminished or disappeared when the holiday or weekend that people left the buildings, or/and symptom experience had not occurred at home within 3 months. Sick Building Syndrome (SBS) was 5 symptom groups. They reported at least one symptom occurring between 1-3 days per week and 4 days per week. Most (80%) participants had experienced at least 1 day per week.

Table 4.1 shows the distribution of SBS in 165 participants. The prevalence of SBS was 80% of participants, and most of the participants (68.5%) had fewer specific symptoms, 1-3 days/week (57.6%) and ≥4 days/week (10.9%), respectively. In descending order, 41.8% of participants have experienced dryness, itching, or irritation skin, occasionally with a rash, 1-3 days/week (34.5%) and ≥4 days/week (7.3%), respectively. Followed by an experience of dry or watering eyes were 40.6%, 1-3 days/week (32.1%), and ≥4 days/week (8.5%), respectively. The equal prevalence

(40.6%) have experienced runny or blocked noses, 1-3 days/week (35.8%) and ≥4 days/week (4.8%), respectively. In addition, an experience of dry or sore throat was 26.7%, 1-3 days/week (21.2%), and ≥4 days/week (5.5%), respectively.

Table 4.1 Number and percentage of Sick Building Syndrome prevalence (n=165).

Sick Building Syndrome	Number	Percent
No	33	20.0
Yes	132	80.0
1. Irritated, dry or watering eyes		
None	98	59.4
1-3 days/week	53	32.1
≥4 days/week	14	8.5
2. Irritated, runny or blocked nose		
None	98	59.4
1-3 days/week	59	35.8
≥4 days/week	8	4.8
3. Dry or sore throat		
None	121	73.3
1-3 days/week	35	21.2
≥4 days/week	9	5.5
4. Dryness, itching or irritation of the skin, occasionally with a rash		
None	96	58.2
1-3 days/week	57	34.5
≥4 days/week	12	7.3
5. Less specific symptoms such as headache, lethargy, irritability and poor concentration		
None	52	31.5
1-3 days/week	95	57.6
≥4 days/week	18	10.9

Ref. code: 25655817320061KEF

4.2 Occupant characteristics data

Table 4.2 presents 165 participants who were female (89.1%) with mean age (± SD) of 36.10 ± 9.06 years (range 22–59). Age was classified participants into three groups. Most the participants (37.6%) were >39 years, followed by 31.5% who were 30-39 years, and the rest 30.9% were <30 years. The majority of workers (64.2%) had no allergy history to grass or tree pollen, animal fur, etc. However, the participants reported allergy factors, as shown in Table 4.3.

There was no significant association between SBS symptoms and gender. Also, there was no significant association between SBS symptoms and age. However, in univariable analysis, participants with allergic history led to 3.02 times higher odds of SBS (95% confidence interval [95% CI]: 1.71-7.81, *p*-value =0.023) compared without allergy history. Collinearity Statistics showed the between allergy disease and allergy history. The participants who had allergy diseases were 10.24 times more likely to be SBS than those who never had allergy disease (COR = 10.24, 95% CI: 1.34-77.95). Therefore, allergy history had a statistically significant relationship with SBS. (Table 4.2).

Table 4.3 shows some of the participants had an allergy history of one or more factors. More than one-third (35.8%) of them had an allergy history. Dust (15.8%) was the majority factor of allergy, followed by animal fur (12.1%) and grass or tree pollen (8.5%), respectively.

Table 4.2 Number and percentage of occupant characteristics, and the relationship of occupant characteristics and SBS (n=165).

Characteristics	Number (%)	SBS		COR (95% CI)	*p*-value
		n	%		
1. Gender					0.386
Male	18 (10.9)	13	72.2	1.00	
Female	147 (89.1)	119	81.0	1.64 (0.54-4.96)	

COR; Crude odds ratio, **p*-value is significant at <0.05.

[a] Able to select more than one answer

Collinearity between allergy history and allergy disease, and allergy disease have collinear with stability/neuroticism.

Table 4.2 Number and percentage of occupant characteristics, and the relationship of occupant characteristics and SBS (n=165). (Cont).

Characteristics	Number (%)	SBS		COR (95% CI)	*p*-value
		n	%		
2. Age					0.601
<30	51 (30.9)	40	78.4	1.06 (0.43-2.60)	
30-39	52 (31.5)	44	84.6	1.60 (0.61-4.19)	
>39	62 (37.6)	48	77.4	1.00	
Mean=36.10, SD=9.064, Min=22, Max=59					
3. Allergy history					0.023 *
No	106 (64.2)	79	74.5	1.00	
Yes	59 (35.8)	53	89.8	3.02 (1.17-7.81)	
Allergic diseases[a]					0.025 *
No	132 (80.0)	100	75.8	1.00	
Yes	33 (20.0)	32	97.0	10.24 (1.34-77.95)	

COR; Crude odds ratio, **p*-value is significant at <0.05.

[a] Able to select more than one answer

Collinearity between allergy history and allergy disease, and allergy disease have collinear with stability/neuroticism.

Table 4.3 Number and percentage of allergy history (n=165).

Allergy history	Number	Percent
Allergy history[a]		
No	106	64.2
Yes	59	35.8
1 Allergy: Grass or tree pollen		
No	151	91.5
Yes	14	8.5
2 Allergy: Animal fur		
No	145	87.9
Yes	20	12.1
3 Allergic diseases [a]		
Allergic rhinitis		
No	150	90.9
Yes	15	9.1

[a] Able to select more than one answer

Table 4.3 Number and percentage of allergy history (n=165). (Cont).

Allergy history	Number	Percent
3 Allergic diseases [a]		
Asthma		
No	159	96.4
Yes	6	3.6
Sinusitis		
No	161	97.6
Yes	4	2.4
Other diseases (SLE, Urticaria, Dust allery)		
No	162	98.2
Yes	3	1.8
4 Allergy: Others[a]		
No	117	70.9
Yes	48	29.1
Dust	26	15.8
Weather	12	7.3
Food & drug	9	5.5
Cockroach	6	3.6
Chemicals & metals	6	3.6

[a] Able to select more than one answer

Ref. code: 25655817320061KEF

4.3 **Work conditions data**

Work conditions of participation explained to worker-related equipment, working hours per week. Also, it shows absent days when they had SBS.

Table 4.4 shows the use of equipment during their work. The result showed that the most equipment was a printer (90.3%), visual display terminals (89.7%), photocopier (70.3%), carbonless paper (40.0%), and fax machines (25.5%), respectively. There was no significant relationship between SBS and work related equipment, carbonless paper, photocopiers, fax machines, and printers. But there was a significant relationship between SBS and VDT. Participants who worked with visual display terminals (VDT) were 3.28 times more likely to be SBS than those who did not VDT used (COR = 3.28, 95% CI: 1.14-9.42, *p*-value =0.027).

Table 4.4 Number and percentage of work related equipment, and the relationship between work related equipment and SBS (n=165).

Work related equipment	Number (%)	SBS		COR (95% CI)	*p*-value
		n	%		
Carbonless paper					0.384
No	99 (60.0)	77	78	1.00	
Yes	66 (40.0)	55	83	1.43 (0.64-3.19)	
Visual display terminal					0.027 *
No	17 (10.3)	10	59	1.00	
Yes	148 (89.7)	122	82	3.28 (1.14-9.42)	
Photocopier					0.932
No	49 (29.7)	39	80	1.00	
Yes	116 (70.3)	93	80	1.04 (0.45-2.38)	
Fax machine					0.789
No	123 (74.5)	99	81	1.00	
Yes	42 (25.5)	33	79	0.89 (0.38-2.10)	
Printer					0.243
No	16 (9.7)	11	69	1.00	
Yes	149 (90.3)	121	81	1.96 (0.63-6.11)	

COR; Crude odds ratio, **p*-value is significant at <0.05.

Table 4.5 shows nearly half (47.9%) of participants worked less than 36 hours/week, followed by worked 36-40 hours/week (31.5%) and worked more than 40 hours/week (20.6%), respectively. The mean (± SD) work hours was 39.39 ± 5.829 hours/week (range 30–56). This study was not significantly associated working hours/week with SBS.

Table 4.5 Number and percentage of working hours/week, and the relationship between working hours/week and SBS (n=165).

Working hours/week	Number (%)	SBS		Crude OR (95% CI)	*p*-value
		n	%		
<36	79 (47.9)	63	80	1.00	0.985
36-40	52 (31.5)	42	81	1.07 (0.44-2.57)	
>40	34 (20.6)	27	79	0.98 (0.36-2.65)	
Mean=39.39, SD=5.829, Min=30, Max=56					

COR; Crude odds ratio, **p*-value is significant at <0.05.

Table 4.6 presents the absent days of participants while they had SBS. More than one-fourth of participants (29.70%) were absent from work. Most of them left their work seldom (23.03%) and sometimes (6.67%).

Table 4.6 Number and percentage of absent days.

Absent days	Number	%
No	116	70.30
Yes	49	29.70
Seldom	38	23.03
Sometimes	11	6.67

Ref. code: 25655817320061KEF

4.4 **Psychosocial factors data**

Psychosocial factors consisted of job stress, job satisfaction, and social support. There were 15 questions about each factor. The scores of each factor were from 1 to 5 with questions and classified into 3 levels that consisted low level (15-30 scores), middle level (31-60 scores), and high level (61-75 scores). The result shown in Table 4.7.

Job stress scoring was a Likert Scale 5-point scale ranging from “Never” on one end to “Always”. Most the participants (98.2%) were at the low/middle level of job stress. The rest (1.8%) was at a high level of job stress. The mean (± SD) job stress score was 44.05 ± 7.626 (range 26–64). There was no significant association between SBS symptoms and job stress. (Table 4.7).

Job satisfaction scoring was a Likert Scale 5-point scale ranging from “Strongly Disagree” on one end to “Strongly”. More than half of the participants (67.3%) were at a low/middle level of job satisfaction, and nearly one-third (32.7%) were high level of job satisfaction. The mean (± SD) job satisfaction score was 56.22 ± 8.020 (range 35–73). There was no significant association between SBS symptoms and job satisfaction. (Table 4.7).

Social support scoring was a Likert Scale 5-point scale ranging from “Strongly Disagree” on one end to “Strongly”. 71.5% of participants got low/middle level social support, followed by 28.5% of participants got high level social support. The mean (± SD) the social support score was 55.50 ± 9.365 (range 26–75). There was no significant association between SBS symptoms and social support. (Table 4.7).

Ref. code: 25655817320061KEF

Table 4.7 Number and percentage of psychosocial factors, and the relationship between psychosocial factors and SBS (n=165).

psychosocial factors	Number (%)	SBS		COR (95% CI)	*p*-value
		n	%		
Job stress					NA
Low/Middle level	162 (98.2)	129	79.6	-	
High level	3 (1.8)	3	100.0	-	
Mean=44.05, SD=7.626, Min=26, Max=64					
Job satisfaction					0.934
Low/Middle level	111 (67.3)	89	80.2	1.03 (0.46-2.33)	
High level	54 (32.7)	43	79.6	1.00	
Mean=56.22, SD=8.020, Min=35, Max=73					
Social support					0.547
Low/Middle level	118 (71.5)	93	78.8	0.76 (0.32-1.83)	
High level	47 (28.5)	39	83.0	1.00	
Mean=55.50, SD=9.365, Min=26, Max=75					

COR; Crude odds ratio, **p*-value is significant at <0.05.

Table 4.8 shows the individual task stress question scores ranging from 1 to 5. The lowest score indicates the least stress cause, while the highest score indicates the greatest cause of stress. The question “It is trouble talking to your boss” was the lowest job stress (1.92 scores). The question “Your job requires you to remember different things” was the highest job stress (4.15 scores), followed by the question “You must keep your mind on your work always” (4.09 scores).

Table 4.8 Job stress question score each item (n=165).

Job stress question	Minimum score	Maximum score	Mean score	Std. Deviation
1. Your job does not let you use the skills and knowledge you learned in school.	1	5	2.73	1.201

Table 4.8 Job stress question score each item (n=165). (Cont).

Job stress question	Minimum score	Maximum score	Mean score	Std. Deviation
2. You cannot use the skills from your previous experience and training.	1	5	2.58	1.132
3. Your job requires you to work very hard.	1	5	2.95	0.964
4. Your job requires you to work very fast.	1	5	3.69	0.908
5. You have to rush to complete work or short on time.	2	5	3.98	0.937
6. Your job requires you to remember different things.	2	5	4.15	0.775
7. You must keep your mind on your work always.	1	5	4.09	0.868
8. You get miserable flow information to carry out your job.	1	5	2.96	0.910
9. You do not get a chance to do the things you do the best	1	5	2.65	1.074
10. Your authority is not enough to properly to do your job.	1	5	2.51	1.091
11. Your group has lots of bickering over who should do what job.	1	5	2.33	1.101
12. Your ideas vary from your supervisor's ideas.	1	5	2.53	0.934
13. You cannot predict your supervisor’s reactions.	1	5	2.72	0.954
14. Your job is too much supervision.	1	5	2.27	0.939
15. It is trouble talking to your boss.	1	4	1.92	0.988

Ref. code: 25655817320061KEF

Table 4.9 shows scores for each job satisfaction questionnaire, with scores ranging from 1 to 5. The lowest score identifies factors that need substantial improvement, while the highest score shows the least factors that need improvement. The question “You are satisfied with your present salary” was the lowest job satisfaction (3.43 scores), followed by the question “You enhance career prospects in your company” (3.45 scores). The question “You get enough break or meal time” was the highest job satisfaction (4.22 scores), followed by the question “You are satisfied with the department as it now stands” (4.04 scores).

Table 4.9 Job satisfaction question score each item (n=165).

Job satisfaction question	Minimum score	Maximum score	Mean score	Std. Deviation
1. Your work is according to your qualifications and skills.	1	5	3.81	0.987
2. You are satisfied with the amount of your responsibility.	1	5	3.75	0.837
3. In your daily work, you are free to make decisions on it.	1	5	3.87	0.805
4. You get enough break or meal time.	1	5	4.22	0.856
5. You can complete tasks during an average day.	1	5	3.78	1.030
6. Job requirements are not taking their toll on your private life.	1	5	3.55	1.044
7. You get a chance to do something about your abilities.	1	5	3.84	0.701
8. You get the opportunity to learn new skills.	1	5	3.95	0.825
9. The company supports you for more training and education.	1	5	3.79	0.936

Ref. code: 25655817320061KEF

Table 4.9 Job satisfaction question score each item (n=165). (Cont).

Job satisfaction question	Minimum score	Maximum score	Mean score	Std. Deviation
10. You feel of accomplishment from the job.	1	5	3.62	0.830
11. You are satisfied with the. department as it now stands	1	5	4.04	0.965
12. You are satisfied with your present salary.	1	5	3.43	1.055
13. You get the praise for doing a good job.	1	5	3.53	0.941
14. You are satisfied with your chances of being promoted to a better position.	1	5	3.59	0.999
15. You enhance career prospects in your company.	1	5	3.45	1.021

Table 4.10 shows scores for each job social support questionnaire scores ranging from 1 to 5. The lowest score indicates a factor that requires greatly increased support. On the contrary, the highest score represents the factor that needs to be least increased support. The question "Your team let you know what they expect from you." was the lowest social support (3.50 scores), followed by the question "Your workplace helps you in special circumstances" (3.55 scores). The question "You feel like you are always included in your circle of the team" was the highest social support (3.87 scores), followed by the question "Your colleagues give you good advice" (3.85 scores).

Table 4.10 Social support question score each item (n=165)

Social support question	Minimum score	Maximum score	Mean score	Std. Deviation
1 You feel like you are always included in your circle of the team.	1	5	3.87	0.885
2. Your team let you know what they expect from you.	1	5	3.50	0.874
3. Your colleagues ask you to join in their activities.	1	5	3.62	0.837
4. Your colleagues give you enough information.	1	5	3.61	0.808
5. Your colleagues give you good advice.	1	5	3.85	0.853
6. Your colleagues give you constructive criticism.	1	5	3.63	0.821
7. Your colleagues always stand by you.	1	5	3.71	0.827
8. Your colleagues lend you a friendly ear.	1	5	3.81	0.818
9. Your colleagues help you to clarify your problems.	1	5	3.73	0.776
10. Your colleagues show you that they are fond of you.	1	5	3.64	0.842
11. Your colleagues reassure you.	1	5	3.64	0.773
12. Your workplace helps you in special circumstances.	1	5	3.55	0.776
13. There is someone cheers you up.	2	5	3.75	0.784

Ref. code: 25655817320061KEF

Table 4.10 Social support question score each item (n=165) (Cont).

Social support question	Minimum score	Maximum score	Mean score	Std. Deviation
14. There is someone who you feel comfortable to talk about intimate personal problems.	1	5	3.78	0.944
15. There is someone whom you trust to help solve your problems.	1	5	3.81	0.890

4.5 **Personality types data**

The Eysenck's Personality Inventory (EPI) measured personality traits and interpreted them into 4 personality types, introvert, extrovert, stable, and neurotic. The extrovert score (E score) was summed and interpreted, 0-12 was introvert, and 13-24 was extrovert. The neurotic score (N score) was summed and interpreted, 0-12 was stable, and 13-24 was neurotic. For personality types, there were 2 domains.

Table 4.11 shows the distribution of personality types in 165 participants. Introversion/Extraversion domain, more than two-thirds of the participants were introverts, and the rest were extroverts (69.1% and 30.9%, respectively). There was no significant association between Introversion/Extraversion domain and SBS. Stability/Neuroticism domain that more than half of the participants were stable. The rest were neurotic (57.6% and 42.4%, respectively). There was a significant association between the neurotic person and SBS symptoms. The neurotic person was 4.23 times more likely to be SBS than the stable person (COR = 4.23, 95% CI: 1.64-10.93, *p*-value =0.002).

Ref. code: 25655817320061KEF

Table 4.11 Number and percentage of personality types, and the relationship between personality types and SBS (n=165).

Personality types	Number (%)	SBS n	SBS %	COR (95% CI)	*p*-value
Introversion/Extraversion					0.736
Introvert	114 (69.1%)	92	80.7	1.15 (0.51-2.56)	
Extrovert	51 (30.9%)	40	78.4	1.00	
Mean=10.63, SD=2.908, Min=4, Max=18					
Stability/Neuroticism					0.002 *
Stable	95 (57.6%)	68	71.6	1.00	
Neurotic	70 (42.4%)	64	91.4	4.23 (1.64-10.93)	
Mean=11.81, SD=4.78, Min=0, Max=22					

COR; Crude odds ratio, **p*-value is significant at <0.05

Table 4.12 shows the percentage of personality types by age. Terms of the Introversion/Extraversion domain showed who was <30 years and >39 years tend to be introvert personality types (74.51%, 72.58%, respectively) more than extrovert personality type (25.49%, 27.42%, respectively). Consistent, the percentage of introverted personality type (59.62%) who was 30-39 years slightly higher than extroverted personality type (40.38%).

Stability/Neuroticism domain showed percentage of stable personality type (74.19%) higher than the percentage of neurotic personality type (25.81%) in >39 year group. However, the percentage of stable personality types who was <30 years (50.98%) and 30-39 years (44.23%) were not different from neurotic personality types (49.02%, 55.77%, respectively).

Table 4.12 Number and percentage of personality types by age (n=165).

Age	Introversion/Extraversion			Stability/Neuroticism		
	Introvert	Extrovert	total	Stable	Neurotic	total
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
<30	38 (74.51)	13 (25.49)	51 (100.00)	26 (50.98)	25 (49.02)	51 (100.00)
30-39	31 (59.62)	21 (40.38)	52 (100.00)	23 (44.23)	29 (55.77)	52 (100.00)
>39	45 (72.58)	17 (27.42)	62 (100.00)	46 (74.19)	16 (25.81)	62 (100.00)

4.6 Indoor air quality data

IAQ included 10 parameters: temperature (T), relative humidity (RH), carbon dioxide CO_2), carbon monoxide (CO), ozone (O_3), formaldehyde (CH_2O), total volatile organic chemicals (TVOCs), particulate, mould, and bacteria. Table 4.13 shows the result of indoor air sampling in each room.

Table 4.13 Detail of indoor air sampling in each room.

Item	Parameter	Room No.								
		1	2	3	4	5	6	7	8	9
1	T (℃)	24.1	25.0	25.3	25.5	24.7	25.9	25.8	25.5	24.4
2	RH (%)	63.4	58.3	53.3	58.1	62.7	55.1	57.4	64.9	65.9
3	CO_2 (ppm)	367	240	186	320	589	368	283	110	407
4	CO (ppm)	0.10	0.10	0.00	0.10	0.51	0.10	0.10	0.10	0.70
5	O_3 (ppm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	CH_2O (ppm)	0.05	0.04	0.06	0.05	0.12	0.11	0.08	0.06	0.20
7	TVOCs (ppm)	1.30	1.00	1.00	1.00	1.11	1.00	1.00	0.88	1.21
8	PM 2.5 (mg/m^3)	5.80	10.00	12.20	9.60	14.90	5.40	6.70	9.09	4.98
	PM 10 (mg/m^3)	14.70	26.80	35.90	31.00	39.80	19.20	18.90	25.00	14.90
9	Mould (cfu/m^3)	305	120	110	155	50	165	90	80	130
10	Bacteria (cfu/m^3)	190	600	250	435	650	410	295	170	610

Table 4.13 IAQ detail of indoor air sampling in each room. (Cont).

Item	Parameter	Room No.								
		10	11	12	13	14	15	16	17	18
1	T (℃)	24.0	27.0	25.6	26.0	23.4	25.0	24.6	24.7	24.6
2	RH (%)	56.9	60	68.9	58.6	56.6	73.2	54.3	54.1	44
3	CO_2 (ppm)	333	134	611	279	208	374	552	353	491
4	CO (ppm)	0.90	0.60	0.20	0.20	0.10	0.10	1.05	0.90	0.60
5	O_3 (ppm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	CH_2O (ppm)	0.07	0.10	0.27	0.34	0.04	0.23	0.20	0.13	0.01
7	TVOCs (ppm)	1.65	0.97	1.10	1.10	1.00	1.00	1.3	1.16	1.28
8	PM 2.5 (mg/m^3)	4.23	6.82	3.20	3.20	5.30	2.30	3.07	4.20	5.65
	PM 10 (mg/m^3)	15.60	23.20	13.20	15.60	15.50	7.30	17.11	9.28	16.40
9	Mould (cfu/m^3)	200	60	60	145	90	35	190	170	70
10	Bacteria (cfu/m^3)	920	1,325	315	310	275	355	280	510	290

Indoor air sampling data compared with SINGAPORE STANDARD SS: 2009 to interpret as within the standard or not. Table 4.14 presents the IAQ result. The temperature mean was 25.06 $\pm$ 0.86°C (range = 23.4–27.0°C). Most (88.9%) were standard temperature, and 11.1% were nonstandard temperature rooms. The relative humidity mean was 59.20 $\pm$ 6.6% (range = 44.0–73.2%). Most (94.4%) of the rooms were standard relative humidity rooms, and one room (5.6%) was nonstandard formaldehyde. The formaldehyde concentration mean was 0.12 $\pm$ 0.09 ppm (range = 0.01–0.34 ppm). More than half (55.6%) of rooms were standard formaldehyde rooms, and nearly a half (44.4%) were nonstandard formaldehyde rooms. Bacteria concentration mean was 455 $\pm$ 289.17 cfu/m^3 (range = 170–1325 cfu/m^3). The 66.7% of rooms were standard bacteria rooms. From six parameters as carbon dioxide, carbon monoxide, ozone, VOCs, particles (PM 2.5, PM 10), and mold, the values were within the safe limits set by SINGAPORE STANDARD SS: 2009. The concentration mean, carbon dioxide was 344.7 $\pm$ 146.3 ppm (range = 110–661 ppm), and carbon monoxide was

0.36 $\pm$ 0.35 ppm (range = 0.00–1.10 ppm). Ozone was lower than limit of detection. VOCs concentration mean was = 1.11 $\pm$ 0.18 ppm (range = 0.88–1.65 ppm). The concentration mean of PM 2.5 and PM 10 were 6.48 $\pm$ 3.42 mg/m^3 (range = 2.30–14.9 mg/m^3), and 19.96 $\pm$ 8.76 mg/m^3, respectively, and mean of mould was 123.6 $\pm$ 67.3 cfu/m^3 (range = 35–305 cfu/m^3).

In addition, more than 10% of the rooms were nonstandard IAQ, including temperature (11.1%), relative humidity (5.6%), formaldehyde (44.4%), and bacteria (33.3%) (Tale 4.14).

Table 4.14 Number and percentage of IAQ nonstandard room and IAQ standard room in each parameter (n=18).

Indoor air quality	Number	Percent
1. Temperature (°C)		
Nonstandard	2	11.1
Standard	16	88.9
Mean=25.06, SD=0.86, Min=23.4, Max=27.0		
2. Relative humidity (%)		
Nonstandard	1	5.6
Standard	17	94.4
Mean=59.2, SD=6.6, Min=44.0, Max=73.2		
3. Carbon dioxide (ppm)		
Standard	18	100.0
Mean=344.7, SD=146.3, Min=110, Max=611		
4. Carbon monoxide (ppm)		
Standard	18	100.0
Mean=0.36, SD=0.35, Min=0.00, Max=1.10		

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Table 4.14 Number and percentage of IAQ nonstandard room and IAQ standard room in each parameter (n=18). (Cont).

Indoor air quality	Number	Percent
5. Ozone (ppm)		
Standard	18	100.0
(Be lower than limit of detection)		
6. Formaldehyde (ppm)		
Nonstandard	8	44.4
Standard	10	55.6
Mean=0.12, SD=0.09, Min=0.01, Max=0.34		
7. Volatile Organic Compounds (ppm)		
Standard	18	100.0
Mean=1.11, SD=0.18, Min=0.88, Max=1.65		
8. Particles (mg/m^3)		
8.1 PM 2.5		
Standard	18	100.0
Mean=6.48, SD=3.42, Min=2.30, Max=14.9		
8.2 PM 10		
Standard	18	100.0
Mean=19.96, SD=8.76, Min=7.30, Max=39.8		
9. Mould (cfu/m^3)		
Standard	18	100.0
Mean=123.6, SD=67.3, Min=35, Max=305		
10. Bacteria (cfu/m^3)		
Nonstandard	6	33.3
Standard	12	66.7
Mean=455.0, SD=289.1, Min=170, Max=1,325		

Ref. code: 25655817320061KEF

All participants (n=165) worked in the rooms that were 6 parameters standard. Six parameters were carbon dioxide, carbon monoxide, ozone, VOCs, particles, and mould. The mean value of each parameter was within the standard values.

Table 4.15 presents the number and percentage among 165 participants who worked in the room related to standard IAQ and nonstandard IAQ. Most (96.4%) of participants worked in standard temperature rooms. There was not a significant association between temperature and SBS. 94.5% of participants worked in standard relative humidity. There was not a significant association between relative humidity and SBS. More than half (52.1%) of participants worked in formaldehyde standard rooms. There was not a significant association between formaldehyde and SBS. In addition, 69.7% of participants worked in standard bacteria rooms. There was not a significant association between bacteria and SBS.

Table 4.15 Number and percentage of participants who worked in the room related to IAQ standard or IAQ nonstandard (n=165).

Indoor air quality	Number (%)	SBS		COR (95% CI)	*p*-value
		n	%		
Temperature					0.415
Nonstandard	6 (3.6)	4	66.7	1.00	
Standard	159 (96.4)	128	80.5	2.06 (0.36-11.79)	
Relative humidity					0.864
Nonstandard	9 (5.5)	7	77.8	1.00	
Standard	156 (94.5)	125	80.1	1.15 (0.23-5.82)	
Formaldehyde					0.640
Nonstandard	79 (47.9)	62	78.5	1.00	
Standard	86 (52.1)	70	81.4	1.20 (0.56-2.57)	
Bacteria					0.398
Nonstandard	50 (30.3)	38	76.0	1.00	
Standard	115 (69.7)	94	81.7	1.41 (0.63-3.16)	

COR; Crude odds ratio, **p*-value is significant at <0.05.

4.7 **Multivariable logistic regression analysis**

An attempt to identify the best model for SBS analysis presents in Table 4.16. That involved a selection of the independent variable to be included in the multivariable logistic regression model from the literature review or the results of univariate analysis. The independent variable had significantly correlated with the dependent variable, with the *p*-value <0.10. The backward stepwise selection was performed to determine the relationship between factors and SBS. Some independent variable that made the model unreliable was excluded. The results presented the adjusted odds ratio (AOR) corresponding to 95% confidence level. The multivariable logistic regression analysis shows that the SBS analysis were independently associated with neurotic personality type (Adjusted odds ratio [AOR] = 4.40, 95% CI: 1.65-11.74, *p*-value =0.003), and visual display terminal used (AOR = 3.42, 95% CI: 1.10-10.61, *p*-value =0.033), and allergy history (AOR = 2.83, 95% CI: 1.05-7.59, *p*-value =0.039).

Table 4.16 A multivariable logistic regression analysis of the factors related to SBS.

Factors	AOR	95% CI	*p*-value
Stability/Neuroticism			0.003 *
Stability	1.00		
Neuroticism	4.40	1.65-11.74	
Visual display terminal			0.033 *
No	1.00		
Yes	3.42	1.10-10.61	
Allergy history			0.039 *
No	1.00		
Yes	2.83	1.05-7.59	

AOR; Adjusted odds ratio, *p-value is significant at <0.05

Ref. code: 25655817320061KEF

4.8 Conclusion

This section summarizes each independent variable, explored, and its relationship to SBS.

4.8.1 Occupant characteristics

Occupant characteristics contained gender, age, and allergy history. Among 165 workers were female (89.1%). Gender was not significantly associated with SBS. Age was between 22–59 years. The mean was 36.10 ± 9.06 years. It was not significantly associated with SBS.

Some of the participants had an allergy history of one or more factors. More than one-third of them had an allergy history (35.8%). For allergy history, participants who had allergy history were 3.02 times more likely to be SBS than those who never had allergy history (COR = 3.02, 95% CI: 1.17-7.81, *p*-value =0.023). Collinearity Statistics showed the between allergy disease and allergy history. The participants who had allergy diseases were 10.24 times more likely to be SBS than those who never had allergy disease (COR = 10.24, 95% CI: 1.34-77.95, *p*-value =0.025). Therefore, allergy history had a statistically significant relationship with SBS.

4.8.2 Work conditions

Work conditions explained work related equipment, working hours/week, and absent days. Terms work related equipment, most participants used printers (90.3%), and visual display used terminals (89.7%). There was no significant relationship between SBS and work-related equipment such as carbonless paper, photocopiers, fax machines, and printers. However, participants who worked with visual display terminals (VDT) were 3.28 times more likely to be SBS than those who did not use VDT (COR=3.28, 95% CI: 1.14-9.42, *p*-value =0.027). Therefore, there was a significant association between SBS and VDT.

Nearly half (47.9%) of participants worked less than 36 hours, 31.5% and 20.6% worked 36-40 hours and more than 40 hours, respectively. The mean work hour was 39.39 ± 5.829 hours (range = 30–56 hours). This study was not significantly associated with working hours/week.

More than one-fourth (29.9%) of participants were absent from work when they had SBS, seldom (23.0%) and sometimes (6.7%), respectively.

4.8.3 Psychosocial factors

Psychosocial factors consisted of job stress, job satisfaction, and social support.

Most of the participants (94.6%) were at the middle level of job stress, followed by low level (3.6%) and high level (1.8%). The mean job stress score was 44.05 ± 7.626, with scores ranging from 26–64 scores. There was no significant association between SBS symptoms and job stress.

More than half of the participants (67.3%) were at the middle level of job satisfaction, and nearly one-third (32.7%) were high level. The mean job satisfaction score was 56.22 ± 8.020, range = 35–73. There was no significant association between SBS symptoms and job satisfaction.

The middle-level social support was 70.9% of participants, followed by the high level (28.5%) and low level (0.6%). The mean social support score was 55.50 ± 9.365, range 26–75. There was no significant association between SBS symptoms and social support.

4.8.4 Personality types

Introversion/Extraversion domain and Stability/Neuroticism domain were 2 domains of Personality types.

Introversion/Extraversion domain, more than two-thirds (69.1%) of participants were introverts, and the rest were extroverts (30.9%), respectively. There was no significant association between SBS symptoms and the introvert /extraversion domain.

Stability/Neuroticism domain, more than half of the participants (57.6%) were stable, and the rest (42.4%) were neurotic. There was a significant association between the neurotic person and SBS symptoms.

The neurotic person was 4.23 times more likely to be SBS than the stable person (COR = 4.23, 95% CI: 1.64-10.93).

4.8.5 Indoor Air Quality

IAQ included 10 parameters: temperature (T), relative humidity (RH), carbon dioxide CO_2), carbon monoxide (CO), ozone (O_3), formaldehyde (CH_2O), total volatile organic chemicals (TVOCs), particulate, mould, and bacteria.

The mean of temperature was 25.06 $\pm$ 0.86°c (range = 23.4–27.0°c). There were 11.1% nonstandard temperature rooms, and 3.6% of participants worked in the 2 nonstandard temperature rooms. There was not a significant association between temperature and SBS.

The mean of relative humidity was 59.2 $\pm$ 6.6% (range = 44.0–73.2%). There were 5.6% nonstandard relative humidity rooms, and 5.5% of participants worked in 1 nonstandard relative humidity room. There was not a significant association between temperature and SBS.

The mean of carbon dioxide concentration was 344.7 $\pm$ 146.3 ppm (range = 110–661 ppm). All rooms were accepted for carbon dioxide.

The mean of carbon monoxide concentration was 0.36 $\pm$ 0.35 ppm (range = 0.00–1.10 ppm). All rooms were accepted for carbon monoxide.

Ozone concentration was lower than the limit detection. All rooms were accepted for ozone.

The mean of formaldehyde concentration was 0.12 $\pm$ 0.09 ppm (range = 0.01–0.34 ppm). Nearly a half (44.4%) of rooms were nonstandard formaldehyde rooms, and 47.9% of participants worked in 8 high concentrated formaldehyde rooms. There was not a significant association between formaldehyde and SBS.

The mean of VOCs was 1.11 $\pm$ 0.18 ppm (range = 0.88–1.65 ppm). All rooms were accepted for VOCs.

Particles were PM 2.5 and PM 10. The mean of PM 2.5 was 6.48 $\pm$ 3.42 mg/m^3 (range = 2.30–14.9 mg/m^3). All of rooms were accepted for PM 2.5. The mean of PM 10 was 19.96 $\pm$ 8.76 mg/m^3 (range = 7.30–39.8 mg/m^3). All rooms (18) were accepted for PM 10.

The mean of mould was 123.6 $\pm$ 67.3 cfu/m^3 (range = 35–305 cfu/m^3). All rooms were accepted for mould.

The mean of bacteria concentration was 455 $\pm$ 289.17 cfu/m^3 (range = 170–1325 cfu/m^3). One-third (33.3%) of rooms were nonstandard bacteria rooms, and 30.3% of participants worked in 6 high concentrated bacteria rooms. There was not a significant association between bacteria and SBS.

4.9 Discussion

Research design: the present is cross-sectional research designed to the investigated relationship between occupant characteristics, work conditions, psychosocial factors, personality types, indoor air quality (IAQ), and SBS symptoms among back office workers in a Thai university hospital. It also investigated the prevalence of sick building syndrome (SBS) in the study area.

Participants' demographics: 165 employees who worked in the study's back offices across 17 departments, including Nursing, Policy and Planning, Finance, Accounting, Internal Audit, Quality Service Development, Human Resource, Health Insurance, Inventory Procurement, Fabric Service, Maintenance, Health Promotion, Registration and Warehouse, Equipment Warehouse, Contract Management, Medical Supplies Warehouse, and Nutrition made up the study's sample. The study's study areas consisted of 18 rooms. The Work Sensation and Sick Building Syndrome Symptoms Questionnaire, as well as the Personality type Questionnaire, were self-administered by the subjects.

In order to evaluate the indoor air quality, ten IAQ parameters were monitored at 19 different locations throughout 18 different rooms. Mold and bacteria samples were taken, but temperature, relative humidity, carbon dioxide, carbon monoxide, ozone, formaldehyde, total volatile organic compounds, and particle data were also recorded.

The findings of this hospital study revealed a significant prevalence of SBS (80%), which was greater than in other hospital investigations (24.62-70.80%) (13-15).

This study found that SBS symptoms among women more than among men (81.0% and 72.2%, respectively). Similarly, Stenberg (1995) reported women had experienced SBS symptoms more than men in some countries, like the Netherlands, Finland, England, and Denmark. But in Iran, SBS symptoms among men were more than among women (54.42% and 45.58%, respectively) (3). This study did not find any significantly associated gender with SBS (*p*-value >0.05). In contrast, previous research (Azuma et al., 2007) reported a statistically significant association between gender and SBS (7).

The present study showed that age was not significantly associated with SBS (*p*-value >0.05). The difference in this study's result, Mentese and Tasdibi (2014) found that general SBS symptoms among old occupants were more than among young ones (60).

According to the findings of a univariable study, workers who had a history of allergies were 3.02 times more likely to have SBS than those who did not (COR = 3.02, 95 percent CI: 1.17-7.81, *p*-value =0.023).

In univariable analysis, the results found that workers who had allergy history were 3.02 times more likely to be SBS than those who had never allergy history (COR = 3.02, 95% CI: 1.17-7.81, *p*-value =0.023). Collinearity Statistics showed between allergy disease and allergy history, workers who had allergy diseases were 10.24 times more likely to be SBS than those who never had allergy disease (COR = 10.24, 95% CI: 1.34-77.95, *p*-value =0.025). In multivariable logistic regression analysis, allergy history had a statistically significant relationship with SBS in this study (AOR = 2.83, 95% CI: 1.05-7.59, *p*-value =0.039). The result was similar to previous studies (Norback, 2009; Sahlberg, 2012) that the prevalence of SBS was related to self-reported allergy (26, 56).

The result from this study showed the relationship between work related equipment and SBS. There was no significant relationship between SBS and work related equipment such as carbonless paper, photocopier, fax machine, and printer. Contrary to earlier studies (Tong, 1991; Skov et al., 1990), laser printers, carbonless paper, photocopy, or photocopiers used were associated with SBS symptoms (30, 65). Nevertheless, the univariable analysis showed that workers who worked with visual display terminals (VDT) were 3.28 times more likely to be SBS than those who did not. VDT use (COR = 3.28, 95% CI: 1.14-9.42, *p*-value =0.027). In multivariable logistic regression analysis, there was a significant association between VDT and SBS (AOR = 3.42, 95% CI: 1.10-10.61, *p*-value = 0.033). Consistent with previous researches (Azuma et al., 2015; Skov et al., 1990), VDT was related to general symptoms, mucosal irritation, and eye irritation (7, 65).

According to the findings of the current study (*p*-value >0.05), there was no statistically significant relationship between working hours/week and SBS. It wasn't the same as what Vafaeenasab et al. (2014) claimed to be strongly related to nurses who worked more than 60 hours per week with SBS affected (2).

The study's findings indicate no association between job stress and SBS (*p*-value >0.05). Unlike earlier research (Heslop, 2002; Ool and Goh, 1997), there was association between SBS symptoms and job stress (5, 72).

The present study found no significant association between SBS symptoms and job satisfaction (*p*-value >0.05). The result of this study did not agree with previous reports (Abdel-Hamid et al., 2013; Kinman and Griffin, 2008) that low job satisfaction was associated with SBS symptoms (4, 68).

The result from this study showed that a significant did not found between social support levels and SBS (*p*-value >0.05). In contrast to previous findings (Mendelson et al., 2000), there was a report significant of participants having higher levels of union and organizational support that were more likely to be found in SBS (62). In another study (Rashid and Zimring, 2008), low support from coworkers and superiors was the risk of SBS among office workers (55).

In univariable analysis, the result of research found that was not a significant relationship between the introversion/extraversion domain and SBS. However, this study showed a significant between neuroticism and SBS. That neuroticism was 4.23 times more likely to be SBS than those who were stable type (COR = 4.23, 95% CI: 1.64-10.93, *p*=0.002).

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In multivariable logistic regression analysis, there was a significant association between neuroticism and SBS (AOR = 4.40, 95% CI: 1.65-11.74, *p*-value = 0.003). Consistent with previous study (Bobi et al, 2009) reported neuroticism related to SBS (152). A previous study on neuroticism was associated with irritable bowel syndrome (82). Neuroticism and physical health issues are probably related. Because neuroticism makes people more susceptible to stress and less social support (82). Greater neuroticism made SBS more vulnerable (153).

This study results that more than 10% of the rooms were nonstandard IAQ. Concerning indoor air quality factors, four parameters, including temperature, relative humidity, formaldehyde, and bacteria found in some nonstandard back office rooms.

The present study found 11.1% nonstandard temperature rooms, and 3.6% of participants worked in those rooms. There was no significant association between temperature and SBS (*p*-value >0.05). These findings do not support an association between indoor temperature and mucosal symptoms such as sneezing, itching, and eye pain (6, 64).

In this study, there was a 5.6% nonstandard relative humidity room, and 5.5% of participants worked in that room. There was no significant relationship between relative humidity and SBS (*p*-value >0.05). Relative humidity showed a significant association with eye pain, skin redness, and sneezing. This finding was in disagreement with Wang's confirmation that the relative humidity in indoor environments was associated with sick building symptoms. (6).

The result from this study showed that there were 44.4% nonstandard formaldehyde rooms, and 47.9% of participants worked in those rooms. Most of the workers used electronic equipment such as computers and printers. In this study, formaldehyde was not significantly associated with SBS (*p*-value >0.05). This finding differs from the previous research by Heimlich that formaldehyde cause SBS (25) and irritates the eyes and the upper or lower respiratory tract (27).

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In the results of this study, there were 33.3% nonstandard bacteria rooms, and 30.3% of participants worked in those rooms. This study showed that bacteria were not significantly associated with SBS (*p*-value >0.05). The difference in this study's result was that indoor bacteria was associated with general SBS symptoms, such as headache, fatigue, and dizziness (60).

Based on the results of this study, the causes of SBS are difficult identify. Possible risk factors elimination may decrease SBS prevalence. This study found not only three independent variables (allergy history, visual display terminal, and neuroticism). Also, four parameters of indoor air quality (temperature, relative humidity, formaldehyde, and bacteria) were nonstandard. Maybe they were the health risks, especially those have an allergy history.

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CHAPTER 5
CONCLUSION AND RECOMMENATION

This chapter has two parts: recommendations and conclusion to the study on Sick Building Syndrome in a university and hospital in Thailand.

5.1 Conclusion

This cross-sectional study investigated personality types, working conditions, psychosocial factors, occupant characteristics, and indoor air quality. In addition to figuring out the incidence of sick building syndrome, researchers looked into the relationship between several factors and SBS in the back-office personnel at a Thai university hospital. Between September and October of 2020, the information was available. Chi-square, frequency distribution, chi-square, the fisher's test, and univariate and multivariate regression were data analyses. Based on the summary of the study's objectives and results in this chapter. Ten IAQ criteria evaluated 18 back-office rooms from seventeen divisions. As part of the data collection, two self-administrative surveys were completed by 165 back office staff.

SBS is at least one symptom experienced in the workplace that has not occurred at home within 3 months. The prevalence of SBS symptoms was 80% among the back office workers. The most frequent symptom group was less specific symptoms such as headache, lethargy, irritability, and poor concentration (68.5%), followed by the skin symptom group (41.8%). The prevalence of the eyes and nose symptom group was equal (40.6%). The least prevalent (26.7%) was the throat symptom group. The participants were seldom absent (23%) and sometimes absent (6.7%) from their work when SBS symptoms occurred, which was considered an impact of all of the above.

The majority of participants were women (89.1%). Their average age was 36.10 years (range 22–59 years). The result showed that there was no significant relationship between occupant characteristics (gender and age) and SBS (*p*-value>0.05). Some participants (35.8%) had allergy history. The majority of participants

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were women (89.1%). Their average age was 36.10 years (range 22–59 years). The result showed that there was no significant relationship between occupant characteristics (gender and age) and SBS (*p*-value>0.05). Some participants (35.8%) had allergy histories such as grass, tree pollen, animal fur, dust, weather, food, drug, cockroach, chemicals, and metal, or had some allergy diseases such as allergic rhinitis, asthma, sinusitis, and other diseases. Allergy history had a statistically significant relationship with SBS (ARO=2.83, 95% confidence interval=1.05-7.59, *p*-value=0.039) such as grass, tree pollen, animal fur, dust, weather, food, drug, cockroach, chemicals, and metal, or had some allergy diseases such as allergic rhinitis, asthma, sinusitis, and other diseases.

The results found that there was no significant relationship between working conditions and equipment (printer, photocopier, carbonless paper, and fax machine) and no relationship between working hours/week and SBS found (*p*-value>0.05). There was significant relationship between visual display terminal (VDT) and SBS (ARO=3.42, 95% confidence interval=1.10-10.61, *p*-value=0.033). The mean work hours/week (± SD) was 39.39 ± 5.829 hours (range 30–56). Most of the participants (47.9%) worked less than 36 hours/week, followed by worked 36-40 hours/week (31.5%) and worked more than 40 hours/week (20.6%), respectively. This study found no significantly associated between working hours/week and SBS.

Most participants (98.2%) had low/middle levels of job stress, and the rest (1.8%) had a high level of job stress. More than half of the participants (67.3%) were at the low/middle level of job satisfaction, and 32.7% of them were job satisfaction at a high level. 71.5% of participants got low/middle-level social support, and 28.5% got high-level social support. There was no significant relationship between psychosocial factors and SBS (*p*-value>0.05).

According to personality types, there was no significant relationship between the introversion/extraversion domain and SBS (*p*-value>0.05). However, this study was on the relationship between the stability/neuroticism domain and SBS. The neurotic person was 4.23 times more likely to be SBS than the stable person. There was significant relationship between neuroticism and SBS (ARO = 4.40, 95% confidence interval=1.65-11.74, *p*-value=0.003).

Temperature, relative humidity, formaldehyde, and bacteria were nonstandard in some back-office rooms. Indoor air quality was not significantly related to SBS (*p*-value>0.05). Some CO_2 levels were record, and the mean of the fourth slot of a room was greater than 700 ppm over outdoor.

Therefore, neuroticism, allergy history, and visual display terminal use were risk factors for SBS. Temperature, relative humidity, formaldehyde, bacteria, and CO_2 were nonstandard in some back office rooms that can be sickness causes. Temperature, relative humidity, formaldehyde, and bacteria can affect those who have an allergy history.

5.2 Recommendations

5.2.1 For implementation

Improving indoor air quality

This study has found neuroticism and allergy history workers associated with SBS. Workers had allergy history such as dust, cockroach, chemicals & metals. An allergy history person was sensitive to the allergen, and minor exposure to the allergen produces an allergic reaction (154). Neuroticism is the personality type that contributed more than the sensory processing sensitivity (SPS) factors as a predictor of subjective health complaints (SHC) (155).

The results of this study, temperature, relative humidity, formaldehyde, bacteria, and CO_2 did not comply with the SINGAPORE STANDARD SS: 2009 in some back-office rooms that can be sickness causes. Temperature, relative humidity, formaldehyde, and bacteria can affect who has an allergy history. In people with an allergic history, pre-existing allergic symptoms occur during the period of high temperature (156). Relative humidity can indirectly affect the incidence of allergies and infectious respiratory diseases. It is related to the survival and probability of effect contact with allergenic organisms, such as viruses and bacteria (157). Acute health effects of bacteria are allergic reactions such as allergic rhinitis (158). There are many formaldehyde sources in hospital indoor environments, such as cleaning products such as detergents, disinfectants, liquid soaps, and shampoos. Also, formaldehyde sources in the back office are electronic equipment, including computers and photocopiers, and other consumer items such as insecticides and paper products (25, 96) Formaldehyde is a sensitizer and irritant. Allergic reactions or hypersensitivity are acute health effects (89, 96).

Therefore, use caution with indoor chemicals such as insecticides and cleaning products with no fragrances and low fumes. Improving indoor air quality can reduce risk factors of SBS and sickness, such as a ventilation fan installed in the room. Also, cleaning can improve the indoor environment and decrease allergy agents (34, 50, 159-161)

Using Visual display terminal (VDT)

Using VDT was related primarily to dermal and eye symptoms (32). Providing information and training to workers that increase the quality of life in the workplace, ergonomic postures, comfort, and adequate lighting levels (162). Also, they have to keep moving and take breaks, such as below (163).

- Change posture and position frequently (unlock the backrest).
- Stand up regularly, walk a few steps, or move and stretch the body.
- Make a conscious effort to plan regular breaks, including short breaks.
- Look into the distance regularly to relieve eye strain.

Psychosocial factors management

The majority of participants (94.6 %) experienced moderate levels of work stress. The greatest source of work stress was the statement that "Your job requires you to remember various things" (4.15 scores). More than half of the participants (67.3%) were at the middle level of job satisfaction. The question “You are satisfied with your present salary.” was the lowest job satisfaction (3.43 scores). The middle-level social support was 70.9% of participants. The question “Your team let you know what they expect from you.” was the lowest social support (3.50 scores). The organization should concern with psychosocial factors and improve them. It can decrease job stress, increase job satisfaction, and increase social support.

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SBS occurs when a back office employee is exposed to or possesses risk factors. There are many risk factors, especially personal factors, and personality types. Indoor air quality in each parameter can change over time. It comes to levels that allow the back office worker to develop SBS symptoms depending on each person. The hospital should have an action plan to achieve good indoor air quality. The organization should advise staff on SBS and how to deal with it. However, at least once a year should survey SBS symptoms. The back office worker moves to the new room, or a new back office worker in the room, should do the specific survey. The survey will explore the prevalence and risk factors of SBS that can reduce back-office worker suffering, decrease absenteeism, and increase productivity.

5.2.2 For further study

The limitation of this study, most of the participants were more female than male (89.1% and 10.9%, respectively). Further study should focus on where the number of male participants is equal to female participants to confirm gender factors in SBS.

This study collected data for one season. Collecting data in different seasons can do for the prevalence and risk factors of sick building syndrome among back office workers. The workplace environment will change when the seasons change, such as temperature and relative humidity. Psychosocial factors may differ from the season that will be affected by workload.

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APPENDICES

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APPENDIX A
WORK SENSATION AND SICK BUILDING SYNDROME SYMPTOMES QUESTIONNAIRE

Explanation

The purpose of this questionnaire would like to inquire occupants who have been working for not less than 3 months in this room. We would like to know work sensation, and symptoms occur while working in this building. This information is not available anywhere else. Do not put your name on any of the forms provided. Your answer is to remain anonymous. The information which you provide will be combined which other answers only in statistical summaries. There are 3 parts as below.

Part 1 Occupant characteristics and work conditions 6 items

Part 2 Work sensation 45 items

Part 3 Your symptoms experience within 3 month while you have spent time at your workplace (usually disappear hours after you were away from it), or symptoms always appear while you spent time at home. 5 items

Part 1 Occupant characteristics and work conditions

1.1 Please answer the following questions by ticking √ in ☐ . .

1. Gender ☐ Male ☐ Female
2. Age (on your last birthday) .... years
3. Allergy history
   1. Grass or tree pollen ☐ No ☐ Yes
   2. Animal fur ☐ No ☐ Yes
   3. Others

      ☐ No ☐ Yes, please identify that you was allergy................................
   4. Allergic diseases diagnosed by a doctor.

      ☐ No ☐ Yes, please identify your underlying disease such as sinusitis, asthma, allergic rhinitis. ....

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1.2 Please answer the following questions by ticking √ in ☐ about your work conditions within 3 months.

1. Work related equipment

   1. Carbonless paper ☐ No ☐ Yes
   2. Visual display terminal ☐ No ☐ Yes
   3. Photocopier ☐ No ☐ Yes
   4. Fax machine ☐ No ☐ Yes
   5. Printer ☐ No ☐ Yes

2. Working hours/week (exclude rest time) .... hours.

3. Absent days (since some symptoms occur while working in workplace only)

   ☐ Never ☐ Seldom ☐ Sometimes ☐ Often ☐ Always

Part 2 Work situation

Please answer the following questions ticking √ in ☐ about your work sensation within 3 months.

2.1 Please answer the questions that affect job stress due to responsibility and supervisors in items 1-15 and rating follows in below.

[1] = Never [2] = Seldom [3] = Sometimes [4] = Often [5] = Always

	Rating of work sensation	[1]	[2]	[3]	[4]	[5]
1	Your job does not let you use the skills and knowledge you learned in school.	☐	☐	☐	☐	☐
2	You cannot use the skills from your previous experience and training.	☐	☐	☐	☐	☐
3	Your job requires you to work very hard.	☐	☐	☐	☐	☐
4	Your job requires you to work very fast.	☐	☐	☐	☐	☐
5	You have to rush to complete work or short on time.	☐	☐	☐	☐	☐
6	Your job requires you to remember different things.	☐	☐	☐	☐	☐
7	You must keep your mind on your work always.	☐	☐	☐	☐	☐
8	You get miserable flow information to carry out your job.	☐	☐	☐	☐	☐
9	You do not get a chance to do the things you do the best	☐	☐	☐	☐	☐

	Rating of work sensation	1	2	3	4	5
10	Your authority is not enough to properly to do your job.	☐	☐	☐	☐	☐
11	Your group has lots of bickering over who should do what job.	☐	☐	☐	☐	☐
12	Your ideas vary from your supervisor's ideas.	☐	☐	☐	☐	☐
13	You cannot predict your supervisor's reactions.	☐	☐	☐	☐	☐
14	Your job is too much supervision.	☐	☐	☐	☐	☐
15	It is trouble talking to your boss.	☐	☐	☐	☐	☐

2.2 Please answer work situation in question No. 1 – 30 and rating follows in below.

1 = Strongly Disagree

2 = Moderately Disagree

3 = Neither Agree nor Disagree

4 = Moderately Agree

5 = Strongly Agree

	Rating of work sensation	1	2	3	4	5
1	Your work is according to your qualifications and skills.	☐	☐	☐	☐	☐
2	You are satisfied with the amount of your responsibility.	☐	☐	☐	☐	☐
3	In your daily work, you are free to make decisions on it.	☐	☐	☐	☐	☐
4	You get enough break or meal time.	☐	☐	☐	☐	☐
5	You can complete tasks during an average day.	☐	☐	☐	☐	☐
6	Job requirements are not taking their toll on your private life.	☐	☐	☐	☐	☐
7	You get a chance to do something about your abilities.	☐	☐	☐	☐	☐
8	You get the opportunity to learn new skills.	☐	☐	☐	☐	☐
9	The company supports you for more training and education.	☐	☐	☐	☐	☐
10	You feel of accomplishment from the job.	☐	☐	☐	☐	☐
11	You are satisfied with the department as it now stands.	☐	☐	☐	☐	☐
12	You are satisfied with your present salary.	☐	☐	☐	☐	☐
13	You get the praise for doing a good job.	☐	☐	☐	☐	☐

Rating of work sensation		1	2	3	4	5
14	You are satisfied with your chances of being promoted to a better position.	☐	☐	☐	☐	☐
15	You enhance career prospects in your company.	☐	☐	☐	☐	☐
16	You feel like you are always included in your circle of the team.	☐	☐	☐	☐	☐
17	Your team let you know what they expect from you.	☐	☐	☐	☐	☐
18	Your colleagues ask you to join in their activities.	☐	☐	☐	☐	☐
19	Your colleagues give you enough information.	☐	☐	☐	☐	☐
20	Your colleagues give you good advice.	☐	☐	☐	☐	☐
21	Your colleagues give you constructive criticism.	☐	☐	☐	☐	☐
22	Your colleagues always stand by you.	☐	☐	☐	☐	☐
23	Your colleagues lend you a friendly ear.	☐	☐	☐	☐	☐
24	Your colleagues help you to clarify your problems.	☐	☐	☐	☐	☐
25	Your colleagues show you that they are fond of you.	☐	☐	☐	☐	☐
26	Your colleagues reassure you.	☐	☐	☐	☐	☐
27	Your workplace helps you in special circumstances.	☐	☐	☐	☐	☐
28	There is someone cheers you up.	☐	☐	☐	☐	☐
29	There is someone who you feel comfortable to talk about intimate personal problems.	☐	☐	☐	☐	☐
30	There is someone whom you trust to help solve your problems.	☐	☐	☐	☐	☐

Part 3 Symptoms experience

Please answer the following your symptoms experienced by ticking √ in ☐ that occur within 3 months. While you spent time at the workplace during working hours, and they diminish or disappear when the holidays or weekends, or/and symptoms experience while you spent time at home.

Symptoms		none	Workplace		Home
			1-3 days/week	≥4 days/week	
1	Irritated, dry or watering eyes (sometimes described as itching, tiredness, redness, burning or difficulty wearing contact lenses).	☐	☐	☐	☐
2	Irritated, runny or blocked nose (sometimes described as congestion, nosebleeds, itchy or stuffy nose).	☐	☐	☐	☐
3	Dry or sore throat (sometimes described as irritation, upper airway irritation or difficulty swallowing).	☐	☐	☐	☐
4	Dryness, itching or irritation of the skin, occasionally with a rash.	☐	☐	☐	☐
5	less specific symptoms such as headache, lethargy, irritability and poor concentration..	☐	☐	☐	☐

APPENDIX B
WORK SENSATION AND SICK BUILDING SYNDROME SYMPTOMES QUESTIONNAIRE (THAI VERSION)

แบบสอบถามความรู้สึกต่องานและกลุ่มอาการที่เกิดขึ้นขณะอยู่ในที่ทำงาน

คำอธิบาย

แบบสอบถามเพื่อสำรวจความรู้สึกต่องานและกลุ่มอาการที่เกิดขึ้นขณะปฏิบัติงานของผู้ที่ปฏิบัติงานในห้องนี้ไม่น้อยกว่า 3 เดือน ข้อมูลที่กรอกจะถูกเก็บไว้เป็นความลับและไม่มีผลต่อการพิจารณาผลการปฏิบัติงานในอนาคต ไม่ต้องระบุชื่อผู้ให้ข้อมูล และข้อมูลจะรวมกันกับคำตอบท่านอื่น ๆ เพื่อใช้ข้อมูลเฉพาะในการสรุปผลทางสถิติเท่านั้น ประกอบด้วย 3 ส่วนดังนี้

ส่วนที่ 1 ข้อมูลทั่วไปและลักษณะการทำงาน จำนวน 6 ข้อ

ส่วนที่ 2 ความรู้สึกต่องาน จำนวน 45 ข้อ

ส่วนที่ 3 อาการที่เกิดขึ้นในเวลาที่ทำงาน (โดยปกติอาการจะดีขึ้นหรือหายไปเมื่อออกจากที่ทำงานหรือหยุดงานในระยะหนึ่ง) หรือ/และอาการที่เกิดขึ้นเมื่อท่านใช้เวลาอยู่ที่บ้าน อาการดังกล่าวเกิดขึ้นในช่วง 3 เดือน จำนวน 5 กลุ่ม

ส่วนที่ 1 ข้อมูลทั่วไปและลักษณะงาน

1.1 กรุณาใส่เครื่องหมาย √ ในช่อง ☐ เกี่ยวกับข้อมูลทั่วไป

1. เพศ ☐ ชาย ☐ หญิง
2. อายุ (ครบรอบปีเต็มในวันเกิดปีล่าสุดของคุณ)..............................ปี
3. ประวัติภูมิแพ้
   1) หญ้าหรือเกสรดอกไม้ ☐ ไม่แพ้ ☐ แพ้
   2) ขนสัตว์ ☐ ไม่แพ้ ☐ แพ้
   3) อื่นๆ ☐ ไม่มี ☐ มี โปรดระบุสิ่งที่แพ้..............................
   4) โรคประจำตัวเกี่ยวกับภูมิแพ้ที่ได้รับการวินิจฉัยจากแพทย์

      ☐ ไม่มี ☐ มี โปรดระบุ (เช่น ไซนัสอักเสบ, หอบหืด, จมูกอักเสบภูมิแพ้) ....

1.2 กรุณาใส่เครื่องหมาย √ ในช่อง ☐ ที่ตรงกับลักษณะการทำงานในช่วงเวลา 3 เดือน

1.อุปกรณ์ที่เกี่ยวข้องกับการทำงาน

1) กระดาษเคมีในตัวหรือเอ็นซีอาร์ (Carbonless Paper) กระดาษที่มีสำเนาในตัวสามารถเขียนติดแผ่นล่าง ใช้สำหรับพิมพ์แบบฟอร์มหรือบิลใบเสร็จรับเงิน ☐ ไม่ใช้ ☐ ใช้

2) คอมพิวเตอร์ ☐ ไม่ใช้ ☐ ใช้

3) เครื่องถ่ายเอกสาร ☐ ไม่ใช้ ☐ ใช้

4) เครื่องโทรสาร ☐ ไม่ใช้ ☐ ใช้

5) ปริ้นเตอร์ ☐ ไม่ใช้ ☐ ใช้

2. จำนวนชั่วโมงการทำงานต่อสัปดาห์ (ไม่รวมเวลาพัก) ....ชั่วโมง

3. การขาดงาน (เนื่องจากมีอาการบางอย่างเกิดขึ้นขณะทำงานในที่ทำงานเท่านั้น)

☐ ไม่เคย ☐ นานๆครั้ง ☐ บางครั้ง ☐ บ่อยครั้ง ☐ เสมอ

ส่วนที่ 2 ความรู้สึกต่องาน

กรุณาใส่เครื่องหมาย √ ในช่อง ☐ เกี่ยวกับความรู้สึกต่องานในช่วง 3 เดือน

2.1 โปรดตอบคำถามที่ส่งผลต่อความเครียดเนื่องจากงานความรับผิดชอบและการมีปฏิสัมพันธ์กับหัวหน้างาน ในข้อ 1-15 โดยให้คะแนนดังต่อไปนี้

(1) = ไม่เคย (2) = นานๆครั้ง (3) = บางครั้ง (4) = บ่อยครั้ง (5) = บ่อยมาก

คะแนนความรู้สึกต่อการทำงาน	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
1. งานของท่านไม่ได้ใช้ทักษะและความรู้ที่เรียนจบมา	☐	☐	☐	☐	☐
2. งานของท่านไม่ได้นำทักษะจากประสบการณ์หรือการฝึกอบรมมาใช้	☐	☐	☐	☐	☐
3. งานของท่านทำให้ท่านต้องทำงานหนักมาก	☐	☐	☐	☐	☐
4. งานของท่านทำให้ท่านต้องทำงานอย่างรวดเร็ว	☐	☐	☐	☐	☐
5. ท่านต้องรีบทำงานให้เสร็จหรือทันเวลา	☐	☐	☐	☐	☐
6. งานของท่านทำให้ท่านต้องจดจำสิ่งต่างๆ	☐	☐	☐	☐	☐
7. ท่านต้องมีสมาธิในการทำงานตลอดเวลา	☐	☐	☐	☐	☐
8. ท่านได้รับข้อมูลที่ส่งมาไม่เพียงพอต่อการดำเนินงานของท่าน	☐	☐	☐	☐	☐
9. ท่านไม่มีโอกาสทำในสิ่งที่ท่านทำได้ดีที่สุด	☐	☐	☐	☐	☐
10. ท่านไม่มีอำนาจเพียงพอที่จะทำหน้าที่ของท่านได้อย่างเหมาะสม	☐	☐	☐	☐	☐
11. ในกลุ่มงานของท่านมีความขัดแย้งเรื่องการแบ่งงาน	☐	☐	☐	☐	☐
12. ความคิดของท่านแตกต่างจากความคิดของหัวหน้า	☐	☐	☐	☐	☐
13. ท่านไม่สามารถคาดเดาปฏิกิริยาของหัวหน้างานได้	☐	☐	☐	☐	☐
14. งานของท่านถูกกำกับดูแลมากเกินไป	☐	☐	☐	☐	☐
15. การพูดคุยกับเจ้านายเป็นปัญหากับท่าน	☐	☐	☐	☐	☐

2.2 โปรดตอบคำถามที่ส่งผลต่อความพึงพอใจต่องานเนื่องจากลักษณะงาน เงินเดือน และความก้าวหน้าในงานในข้อ 1-15 การสนับสนุนทางสังคมจากองค์กรและผู้ร่วมงานในข้อ 16-30 โดยให้คะแนนดังต่อไปนี้

(1) = ไม่เห็นด้วยอย่างยิ่ง

(2) = ไม่เห็นด้วยปานกลาง

(3) = ไม่แน่ใจ

(4) = เห็นด้วยปานกลาง

(5) = เห็นด้วยอย่างยิ่ง

คะแนนความรู้สึกต่อการทำงาน	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
1. งานของท่านเป็นไปตามคุณวุฒิและทักษะของท่าน	☐	☐	☐	☐	☐
2. ท่านพอใจกับปริมาณงานที่รับผิดชอบ	☐	☐	☐	☐	☐
3. ท่านมีอิสระในการตัดสินใจในงานประจำ	☐	☐	☐	☐	☐
4. ท่านมีเวลาพักหรือรับประทานอาหารอย่างเพียงพอ	☐	☐	☐	☐	☐
5. โดยทั่วไปท่านสามารถทำงานให้เสร็จสิ้นระหว่างวัน	☐	☐	☐	☐	☐
6. การทำงานไม่ได้ส่งผลกระทบต่อชีวิตส่วนตัวของท่าน	☐	☐	☐	☐	☐
7. ท่านมีโอกาสได้ทำบางอย่างที่ใช้ความสามารถของท่าน	☐	☐	☐	☐	☐
8. ท่านมีโอกาสได้เรียนรู้ทักษะใหม่ๆ	☐	☐	☐	☐	☐
9. ที่ทำงานให้การสนับสนุนท่านให้ได้รับการฝึกอบรมและการศึกษาเพิ่มเติม	☐	☐	☐	☐	☐
10. ท่านรู้สึกว่าประสบความสำเร็จจากการทำงาน	☐	☐	☐	☐	☐
11. ท่านพอใจกับแผนกที่ทำงานอยู่	☐	☐	☐	☐	☐
12. ท่านพอใจกับเงินเดือนปัจจุบัน	☐	☐	☐	☐	☐
13. ท่านได้รับการยกย่องเมื่อท่านปฏิบัติได้ดี	☐	☐	☐	☐	☐
14. ท่านพอใจกับการมีโอกาสได้เลื่อนตำแหน่งที่ดีขึ้น	☐	☐	☐	☐	☐
15. ท่านมีโอกาสก้าวหน้าในอาชีพจากที่ทำงานของท่าน	☐	☐	☐	☐	☐
16. ท่านรู้สึกว่าท่านเป็นส่วนหนึ่งของทีมเสมอ	☐	☐	☐	☐	☐
17. ทีมของท่านแจ้งให้ท่านทราบถึงสิ่งที่พวกเขาคาดหวังจากท่าน	☐	☐	☐	☐	☐
18. ท่านได้รับเชิญจากผู้ร่วมงานให้เข้าร่วมกิจกรรมของพวกเขา	☐	☐	☐	☐	☐
19. ผู้ร่วมงานให้ข้อมูลข่าวสารที่เพียงพอแก่ท่าน	☐	☐	☐	☐	☐
20. ผู้ร่วมงานให้คำแนะนำที่ดีแก่ท่าน	☐	☐	☐	☐	☐

คะแนนความรู้สึกต่อการทำงาน	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
21. ผู้ร่วมงานของท่านให้คำวิจารณ์ที่สร้างสรรค์	☐	☐	☐	☐	☐
22. ผู้ร่วมงานของท่านยืนเคียงข้างท่าน	☐	☐	☐	☐	☐
23. ผู้ร่วมงานรับฟังท่านอย่างเป็นมิตร	☐	☐	☐	☐	☐
24. ผู้ร่วมงานช่วยท่านชี้แจงปัญหาที่เกิดกับท่าน	☐	☐	☐	☐	☐
25. ผู้ร่วมงานแสดงเห็นว่าพวกเขารักท่าน	☐	☐	☐	☐	☐
26. ผู้ร่วมงานทำให้ท่านมั่นใจ	☐	☐	☐	☐	☐
27. ที่ทำงานให้ความช่วยเหลือท่านเป็นพิเศษ	☐	☐	☐	☐	☐
28. มีคนที่สนับสนุนการทำงานของท่าน	☐	☐	☐	☐	☐
29. มีคนที่ท่านสนิทสามารถพูดคุยเรื่องส่วนตัวได้อย่างสบายใจ	☐	☐	☐	☐	☐
30. มีคนที่ท่านวางใจในการช่วยแก้ปัญหาของท่าน	☐	☐	☐	☐	☐

ส่วนที่ 3 อาการที่เกิดขึ้นในขณะที่ท่านอยู่ในที่ทำงานและบ้าน

กรุณาใส่เครื่องหมาย √ ในช่อง ☐ ตอบอาการที่เคยเกิดขึ้นกับท่าน ในช่วง 3 เดือน ในขณะที่ใช้เวลาอยู่ในที่ทำงานของท่าน (โดยปกติอาการจะหายไปหลังจากออกจากบริเวณที่ทำงานหรือหายในวันหลังจากที่ท่านไม่อยู่ที่ทำงาน) หรือ/และอาการดังกล่าวที่เกิดขึ้นที่บ้าน

	อาการ	ไม่เคย	ที่ทำงาน		ที่บ้าน
			1-3 วัน/สัปดาห์	≥4 วัน/สัปดาห์	
1	ระคายเคืองตา ตาแห้งหรือน้ำตาไหล (เช่น คัน, ล้า, แดง, แสบหรือความยากลำบากในการสวมใส่คอนแทคเลนส์)				
2	ระคายเคืองจมูก น้ำมูกไหล หรือจมูกอุดตัน (เช่น คันจมูก คัดหรือแน่นจมูก, หายใจไม่สะดวก, เลือดกำเดาไหล)				
3	แห้งหรือเจ็บคอ (เช่น ระคายเคืองคอหรือทางเดินหายใจส่วนบน, กลืนลำบาก)				
4	แห้ง คัน หรือระคายเคืองผิวหนัง, มีผื่นขึ้น				
5	อื่นๆ เช่น ปวดศีรษะ, ง่วงซึม, หงุดหงิด, ขาดสมาธิ				

APPENDIX C
PERSONALITY TYPE QUESTIONNAIRE

Explanation

The purpose this questionnaire would like to inquiry occupants who have been working for not less than 3 months. We would like to know about your trait. This information is not available anywhere else. Do not put your name on any of the forms provided. Your answer are to remain anonymous. The information which you provide will be combined which other answers only in statistical summaries.

Please answer 57 questions about your trait by ticking √ in ☐ of Yes or No follows in below.

	Question	Yes	No
1	Do you often long for excitement?	☐	☐
2	Do you often need understanding friends to cheer you up?	☐	☐
3	Are you usually carefree?	☐	☐
4	Do you find it very hard to take no for an answer?	☐	☐
5	Do you stop and think things over before doing anything?	☐	☐
6	If you say you will do something do you always keep your promise, no matter how inconvenient it might be to do so?	☐	☐
7	Do your moods go up and down?	☐	☐
8	Do you generally do and say things quickly without stopping to think?	☐	☐
9	Do you ever feel 'just miserable' for no good reason?	☐	☐
10	Would you do almost anything for a dare?	☐	☐
11	Do you suddenly feel shy when you want to talk to an attractive stranger?	☐	☐
12	Once in a while do you lose your temper and get angry?	☐	☐
13	Do you often do things on the spur of the moment?	☐	☐
14	Do you often worry about things you should have done or said?	☐	☐
15	Generally do you prefer reading to meeting people?	☐	☐

	Question	Yes	No
16	Are your feelings rather easily hurt?	☐	☐
17	Do you like going out a lot?	☐	☐
18	Do you occasionally have thoughts and ideas that you would not like other people to know about?	☐	☐
19	Are you sometimes bubbling over with energy and sometimes very sluggish?	☐	☐
20	Do you prefer to have few but special friends?	☐	☐
21	Do you daydream a lot?	☐	☐
22	When people shout at you do you shout back?	☐	☐
23	Are you often troubled about feelings of guilt?	☐	☐
24	24 Are all your habits good and desirable ones?	☐	☐
25	Can you usually let yourself go and enjoy yourself a lot at a lively party?	☐	☐
26	Would you call yourself tense or 'highly strung'?	☐	☐
27	Do other people think of you as being very lively?	☐	☐
28	After you have done something important, do you come away feeling you could have done better?	☐	☐
29	Are you mostly quiet when you are with other people?	☐	☐
30	Do you sometimes gossip?	☐	☐
31	Do ideas run through your head so that you cannot sleep?	☐	☐
32	If there is something you want to know about, would you rather look it up in a book than talk to someone about it?	☐	☐
33	Do you get palpitations or thumping in your heart?	☐	☐
34	Do you like the kind of work that you need to pay close attention to?	☐	☐
35	Do you get attacks of shaking or trembling?	☐	☐
36	Would you always declare everything at customs, even if you knew you could never be found out?	☐	☐
37	Do you hate being with a crowd who play jokes on one another?	☐	☐
38	Are you an irritable person?	☐	☐
39	Do you like doing things in which you have to act quickly?	☐	☐

Question		Yes	No
40	Do you worry about awful things that might happen?	▢	▢
41	Are you slow and unhurried in the way you move?	▢	▢
42	Have you ever been late for an appointment or work?	▢	▢
43	Do you have many nightmares?	▢	▢
44	Do you like talking to people so much that you never miss a chance of talking to a stranger?	▢	▢
45	Are you troubled by aches and pains?	▢	▢
46	Would you be very unhappy if you could not see lots of people most of the time?	▢	▢
47	Would you call yourself a nervous person?	▢	▢
48	Of all the people you know, are there some whom you definitely do not like?	▢	▢
49	Would you say that you were fairly self-confident?	▢	▢
50	Are you easily hurt when people find fault with you or your work?	▢	▢
51	Do you find it hard to really enjoy yourself at a lively party?	▢	▢
52	Are you troubled by feelings of inferiority?	▢	▢
53	Can you easily get some life into a dull party?	▢	▢
54	Do you sometimes talk about things you know nothing about?	▢	▢
55	Do you worry about your health?	▢	▢
56	Do you like playing pranks on others?	▢	▢
57	Do you suffer from sleeplessness?	▢	▢

APPENDIX D
PERSONALITY TYPE QUESTIONNAIRE (THAI VERSION)

แบบสอบถามคุณลักษณะ

คำอธิบาย

วัตถุประสงค์ของแบบสอบถามนี้ต้องการสอบถามผู้ที่ปฏิบัติงานในแผนกปัจจุบันไม่น้อยกว่า 3 เดือน ผู้วิจัยอยากทราบคุณลักษณะของท่าน ข้อมูลที่กรอกจะถูกเก็บไว้เป็นความลับ ไม่ต้องระบุชื่อผู้ให้ข้อมูลและข้อมูลจะรวมกันกับคำตอบท่านอื่นๆ เพื่อใช้ข้อมูลเฉพาะในการสรุปผลทางสถิติเท่านั้น

โปรดตอบคำถามเกี่ยวกับคุณลักษณะของท่าน โดยทำเครื่องหมาย √ ใน ☐ จำนวน 57 ข้อ

คำถาม	ใช่	ไม่ใช่
1. ท่านมักตื่นเต้นเป็นเวลานาน	☐	☐
2. ท่านมักต้องการเพื่อนที่เข้าใจเพื่อเป็นกำลังใจ	☐	☐
3. ท่านเป็นคนไม่ค่อยกังวล	☐	☐
4. ท่านคิดว่าเป็นเรื่องที่ยากมากที่จะยอมรับคำปฏิเสธ	☐	☐
5. ท่านหยุดและคิดก่อนที่จะทำสิ่งต่างๆ	☐	☐
6. ท่านจะทำตามที่สัญญาเสมอไม่ว่าจะลำบากแค่ไหน	☐	☐
7. อารมณ์ของท่านขึ้นๆ ลงๆ	☐	☐
8. ปกติท่านจะพูดและทำสิ่งต่างๆอย่างรวดเร็ว โดยไม่ได้หยุดคิดก่อน	☐	☐
9. ท่านเคยรู้สึกเป็นทุกข์โดยไร้เหตุผล	☐	☐
10. ท่านชอบทำในเรื่องที่ค่อนข้างท้าทายความสามารถ	☐	☐
11. ท่านรู้สึกเขินเมื่ออยากพูดกับคนแปลกหน้าที่น่าสนใจ	☐	☐
12. นานๆ ครั้ง ท่านอารมณ์เสียและโกรธ	☐	☐
13. ท่านมักทำสิ่งต่างๆ โดยไม่ได้เตรียมตัว	☐	☐
14. ท่านมักจะวิตกกังวลกับสิ่งที่ท่านควรจะทำหรือพูด	☐	☐
15. ปกติท่านชอบศึกษาบุคคลที่ได้พบ	☐	☐
16. ท่านเป็นคนขี้น้อยใจ	☐	☐
17. ท่านชอบออกไปเที่ยวนอกบ้าน	☐	☐
18. บางครั้งท่านมีความคิดและสิ่งที่คิดไม่ต้องการให้ผู้อื่นรู้	☐	☐

คำถาม	ใช่	ไม่ใช่
19. บางครั้งท่านขยันมากและบางครั้งก็เกียจคร้านมาก	☐	☐
20. ท่านชอบมีเพื่อนน้อยแต่เป็นเพื่อนที่ดี	☐	☐
21. ท่านสร้างวิมานในอากาศมากมาย	☐	☐
22. ท่านจะตะโกนใส่กลับเมื่อมีคนตะโกนใส่ท่าน	☐	☐
23. ท่านมักจะกังวลกับสิ่งที่รู้สึกผิด	☐	☐
24. ท่านเป็นคนนิสัยดีและเป็นที่ชื่นชอบ	☐	☐
21. ท่านสร้างวิมานในอากาศมากมาย	☐	☐
25. ปกติท่านสามารถออกไปสนุกสนานกับการสังสรรค์	☐	☐
26. ท่านคิดว่าท่านเป็นคนเครียดหรือขี้หงุดหงิด	☐	☐
27. คนอื่นคิดว่าท่านเป็นคนที่สนุกสนานร่าเริงมาก	☐	☐
28. หลังจากท่านทำสิ่งที่สำคัญแล้ว ท่านรู้สึกว่าท่านควรทำให้ดีกว่า	☐	☐
29. ท่านมักจะเงียบเมื่ออยู่กับคนอื่น	☐	☐
30. บางครั้งท่านก็ซุบซิบผู้อื่น	☐	☐
31. ท่านมีเรื่องที่คิดอยู่ในหัวจนนอนไม่หลับ	☐	☐
32. หากมีบางสิ่งที่ท่านอยากรู้ท่านจะค้นหาในหนังสือมากกว่าจะพูดคุยกับคนอื่น	☐	☐
33. ท่านมีอาการใจสั่นหรือหัวใจเต้นแรง	☐	☐
34. ท่านชอบงานประเภทที่ต้องใส่ใจอย่างใกล้ชิด	☐	☐
35. ท่านเกิดอาการสั่นหรือตัวสั่น	☐	☐
36. ท่านแสดงทุกอย่างต่อศุลกากร แม้ว่าท่านรู้ว่าไม่สามารถถูกตรวจพบ	☐	☐
37. ท่านเกลียดที่จะอยู่กับกลุ่มคนที่ทำให้ผู้อื่นดูตลก	☐	☐
38. ท่านเป็นคนขี้หงุดหงิด	☐	☐
39. ท่านชอบทำสิ่งที่ต้องดำเนินการอย่างรวดเร็ว	☐	☐
40. ท่านกังวลเกี่ยวกับเรื่องแย่ๆที่อาจเกิดขึ้น	☐	☐
41. ท่านเป็นคนที่เคลื่อนไหวช้าและไม่รีบเร่ง	☐	☐
42. ท่านเคยไปตามนัดหรือมาทำงานสาย	☐	☐
43. ท่านนอนฝันร้ายบ่อยครั้ง	☐	☐
44. ท่านชอบพูดคุยกับคนมากจนไม่เคยพลาดโอกาสที่จะได้คุยกับคนแปลกหน้า	☐	☐
45. ท่านทรมานกับอาการปวดเมื่อย	☐	☐
46. ท่านจะไม่มีความสุขอย่างมากถ้าไม่ได้ใช้เวลาส่วนใหญ่พบปะผู้คนจำนวนมาก	☐	☐

Ref. code: 25655817320061KEF

คำถาม	ใช่	ไม่ใช่
47. ท่านคิดว่าท่านเป็นคนขี้กังวล	☐	☐
48. ในบรรดาคนที่ท่านรู้จักมีบางคนที่ท่านไม่ชอบ	☐	☐
49. ท่านคิดว่าท่านเป็นคนมั่นใจในตัวเอง	☐	☐
50. ท่านมักไม่สบายใจเมื่อมีคนพบว่าท่านหรืองานของท่านบกพร่อง	☐	☐
51. ท่านรู้สึกว่าตัวเองไม่มีความสุขกับการพบปะสังสรรค์ที่สนุกสนาน	☐	☐
52. ท่านไม่สบายใจกับการที่รู้สึกด้อยกว่า	☐	☐
53. ท่านสามารถอยู่ร่วมกับกลุ่มที่น่าเบื่อได้ไม่ยาก	☐	☐
54. บางครั้งท่านพูดเกี่ยวกับสิ่งที่ท่านไม่รู้อะไรเลย	☐	☐
55. ท่านกังวลเกี่ยวกับสุขภาพ	☐	☐
56. ท่านชอบเล่นแผลงๆ กับบุคคลอื่น	☐	☐
57. ท่านประสบปัญหาจากการนอนไม่หลับ	☐	☐

APPENDIX E
FORM OF PARTICIPANT INFORMATION SHEET (THAI VERSION)

เอกสารให้ข้อมูลสำหรับอาสาสมัครวิจัย

ชื่อเรื่อง (ไทย) กลุ่มอาการที่เกิดขึ้นขณะปฏิบัติงานอยู่ในอาคารในโรงพยาบาลมหาวิทยาลัยแห่งหนึ่งในประเทศไทย

ชื่อเรื่อง (อังกฤษ) Sick Building Syndrome in a University Hospital in Thailand

ชื่อผู้วิจัย นางสาวพิลาส สว่างสุนทรเวศย์ ตำแหน่ง นักศึกษาระดับปริญญาเอก หลักสูตรนานาชาติ ด้านอาชีวอนามัยและอนามัยสิ่งแวดล้อม คณะสาธารณสุขศาสตร์ มหาวิทยาลัยธรรมศาสตร์ ปทุมธานี

สถานที่ติดต่อผู้วิจัย

คณะสาธารณสุขศาสตร์ มหาวิทยาลัยธรรมศาสตร์ศูนย์รังสิต อาคารปิยชาติ ชั้น 10 ตำบลคลองหนึ่ง อำเภอคลองหลวง จังหวัดปทุมธานี รหัสไปรษณีย์ 12121

โทรศัพท์ 02-986-9213-9

โทรศัพท์มือถือ 0899920536 E-mail: safety1122@hotmail.com

อาจารย์ที่ปรึกษา ผศ.ดร.สร้อยสุดา เกสรทอง

สถานที่ติดต่อ คณะสาธารณสุขศาสตร์ มหาวิทยาลัยธรรมศาสตร์ศูนย์รังสิต อาคารปิยชาติ ชั้น 10 ตำบลคลองหนึ่ง อำเภอคลองหลวง จังหวัดปทุมธานี รหัสไปรษณีย์ 12121

โทรศัพท์ 02-986-9213-9

โทรศัพท์มือถือ 0895343223 E-mail: k.soisuda@fph.tu.ac.th

ข้อมูลสำหรับอาสาสมัครวิจัย ประกอบด้วย

1. การเชิญท่านเข้าร่วมในการวิจัยก่อนที่ท่านจะตัดสินใจเข้าร่วมในการวิจัย มีความจำเป็นที่ท่านควรทำความเข้าใจว่างานวิจัยนี้ทำเพราะเหตุใด และเกี่ยวข้องกับอะไร กรุณาใช้เวลาในการอ่านข้อมูลต่อไปนี้อย่างละเอียดรอบคอบ และสอบถามข้อมูลเพิ่มเติมหรือข้อมูลที่ไม่ชัดเจนได้ตลอดเวลา

2. เหตุผลและความจำเป็นที่ต้องทำการวิจัย

กลุ่มอาการที่เกิดขึ้นเมื่ออยู่ในอาคารอาจเกิดขึ้นในขณะปฏิบัติงาน งานวิจัยเกี่ยวกับกลุ่มอาการเหล่านี้มีการศึกษาในประเทศที่มีอากาศหนาวเย็นเป็นส่วนใหญ่ ในขณะที่ประเทศที่มีสภาพอากาศที่ร้อนชื้นยังมีการวิจัยที่น้อยกว่า ประทศไทยอยู่ในกลุ่มที่มีสภาพอากาศร้อนชื้นจึงมีการใช้เครื่องปรับอากาศอย่างกว้างขวาง ส่วนใหญ่เป็นเครื่องปรับอากาศที่ใช้เป็นแบบแยกส่วนและไม่มีการ

ระบายอากาศ ทำให้คุณภาพอากาศภายในอาคารซึ่งเป็นสถานที่ปฏิบัติงานอาจมีผลให้เกิดอาการดังกล่าวขึ้นขณะปฏิบัติงานอยู่ในอาคาร ปัจจัยทางจิตสังคม เช่น ความเครียดจากทำงาน ความพึงพอใจต่องาน การได้รับการสนับสนุนในการทำงาน คุณลักษณะส่วนบุคคล ปัจจัยเหล่านี้อาจส่งผลเช่นกัน ทำให้ผู้ปฏิบัติงานรู้สึกไม่สุขสบายขณะปฏิบัติงาน อาจขอเปลี่ยนสถานทำงานหรือต้องขาดงาน ในบางประเทศมีการลาออกจากงานเนื่องจากอาการเหล่านี้ มีรายงานผลของอาการที่เกิดขึ้นของขณะปฏิบัติงานทำให้ผลงานลดลงถึง 20% ในการปฏิบัติงานในโรงพยาบาลพบว่ามีการเกิดอาการเหล่านี้เช่นกัน ประเทศไทยมีการศึกษาในโรงพยาบาลไม่มากแต่พบว่ามีความชุกสูงถึง 70.80% ของผู้ที่ปฏิบัติงานในอาคาร เจ้าหน้าที่ในสำนักงานจำเป็นต้องใช้อุปกรณ์สำนักงานเป็นประจำ เช่น คอมพิวเตอร์ กระดาษเคมีในตัว เครื่องถ่ายเอกสาร เครื่องโทรสาร ปริ้นเตอร์ เป็นต้น อุปกรณ์เหล่านี้เป็นสาเหตุของอาการที่เกิดขึ้นเมื่ออยู่ในอาคาร

ดังนั้นผู้วิจัยจึงศึกษาความชุก ปัจจัยที่อาจส่งผลทำให้เกิดอาการขณะปฏิบัติงานของเจ้าหน้าที่ในสำนักงานของโรงพยาบาลมหาวิทยาลัย โดยสำรวจข้อมูลทั่วไปและลักษณะการทำงาน ความรู้สึกต่องาน คุณลักษณะ รวมทั้งการตรวจวัดคุณภาพอากาศในสถานที่ปฏิบัติงาน เพื่อศึกษาปัจจัยใดมีความสัมพันธ์กับการเกิดอาการ เพื่อลดความรู้สึกไม่สุขสบายหรืออาการขาดงาน และช่วยเพิ่มประสิทธิผลของงาน

3. วัตถุประสงค์ของการวิจัย

- เพื่อศึกษาความชุกของกลุ่มอาการที่เกิดขึ้นขณะปฏิบัติงานอยู่ในอาคาร

- เพื่อสำรวจคุณภาพอากาศภายในสถานที่ปฏิบัติงาน รวมทั้งความเครียดจากทำงาน ความพึงพอใจต่องาน การได้รับการสนับสนุนในการทำงาน คุณลักษณะส่วนบุคคลของพนักงานสำนักงานในพื้นที่ศึกษา

- เพื่อศึกษาความสัมพันธ์ระหว่างคุณภาพอากาศภายในสถานที่ปฏิบัติงาน รวมทั้งความเครียดจากการทำงาน ความพึงพอใจต่องาน การได้รับการสนับสนุนในการทำงาน คุณลักษณะส่วนบุคคล และอาการกลุ่มอาการที่เกิดขึ้นขณะปฏิบัติงาน

4. รายละเอียดของอาสาสมัครวิจัย

4.1 ลักษณะของอาสาสมัครวิจัยและวิธีการได้มาซึ่งอาสาสมัครวิจัย

4.1.1 เกณฑ์การคัดเข้า

เจ้าหน้าที่ที่ปฏิบัติงานส่วนสำนักงานของโรงพยาบาลมหาวิทยาลัยแห่งหนึ่งในประเทศไทย อายุ 18 ปีขึ้นไป ที่มีความเฉพาะเจาะจง โดยเป็นฝ่ายสนับสนุนที่มีลักษณะงานในการบริหารจัดการหรือการสนับสนุน ทำงานในส่วนสำนักงานโดยไม่ได้ปฏิบัติงานในการให้บริการแก่ผู้มารับบริการในโรงพยาบาล และปฏิบัติงานในพื้นที่ปัจจุบันไม่น้อยกว่า 3 เดือน ปฏิบัติงานในห้องที่ใช้เครื่องปรับอากาศที่แยกจากส่วนกลาง

4.1.2 เกณฑ์การคัดออก

- เจ้าหน้าที่ที่ไม่ได้ปฏิบัติงานในห้องทำงานปัจจุบัน รวมกันเกิน 2 สัปดาห์ ภายใน 3 เดือนที่ผ่านมา เช่น ลาพักผ่อน ลาป่วย อบรม ปฏิบัติงานนอกสถานที่ เป็นต้น

4.1.3 เกณฑ์การยุติ

กลุ่มตัวอย่างมีความประสงค์ที่จะหยุดให้ข้อมูล หรือถอนตัวจากกลุ่มตัวอย่าง

4.2 กลุ่มอาสาสมัครวิจัย เจ้าหน้าที่ที่ปฏิบัติงานส่วนสำนักงานของโรงพยาบาลมหาวิทยาลัยแห่งหนึ่งในประเทศไทย ซึ่งเป็นกลุ่มอาสาสมัครที่มีความเฉพาะเจาะจงในการศึกษาวิจัยครั้งนี้ ปฏิบัติงานพื้นที่ศึกษาจำนวน 17 แผนก รวม 18 ห้อง ใช้วิธีการจับฉลากรายชื่ออาสาสมัครจำนวนตามสัดส่วนของแต่ละห้อง รวมทั้งหมด 165 คน

4.3 เหตุผลที่ได้รับเชิญเข้าร่วมโครงการวิจัย

การวิจัยนี้มีวัตถุประสงค์เพื่อศึกษาความชุกของกลุ่มอาการที่เกิดขึ้นขณะปฏิบัติงานอยู่ในอาคาร ความเครียดจากทำงาน ความพึงพอใจต่องาน การได้รับการสนับสนุนในการทำงาน คุณลักษณะส่วนบุคคลของเจ้าหน้าที่ และสำรวจคุณภาพอากาศภายในสถานที่ปฏิบัติงาน เพื่อหาว่าปัจจัยเหล่านี้ว่ามีความสัมพันธ์กับกลุ่มอาการที่เกิดขึ้นในขณะปฏิบัติงานหรือไม่ เพื่อเป็นแนวทางในการลดความชุกของกลุ่มอาการที่เกิดขึ้นขณะปฏิบัติงานอยู่ในอาคาร ลดการขาดงาน ดังนั้นข้อมูลที่ได้รับจากอาสาสมัครงานวิจัยจึงมีความสำคัญอย่างในการดำเนินงานวิจัยดังกล่าว

5. ข้อมูลกระบวนการการวิจัยที่กระทำต่ออาสาสมัครวิจัย

อาสาสมัครจะได้รับแบบสอบถามจำนวน 2 ชุด ที่มีเลขที่แบบสอบถามตรงกันและแยกตามห้องเพื่อใช้ประเมินผลทางสถิติโดยรวม ร่วมกับการตรวจวัดคุณภาพอากาศภายในสถานที่ปฏิบัติงานของอาสาสมัคร แบบสอบถามชุดที่ 1 เป็นแบบสอบถามเพื่อสำรวจความรู้สึกต่องานและกลุ่มอาการที่เกิดขึ้นในที่ทำงานและบ้านในช่วง 3 เดือนล่าสุด แบบสอบถามชุดที่ 2 เป็นแบบสอบถามคุณลักษณะของอาสาสมัคร

อาสาสมัครตอบแบบสอบถามด้วยตนเอง ไม่ต้องระบุชื่อผู้ตอบ ผู้วิจัยหรือผู้ช่วยวิจัยจะขอรับแบบสอบถามคืนใน 1 สัปดาห์ แบบสอบถามจะถูกเก็บเป็นความลับ แบบสอบถามจะถูกทำลายภายใน 2 ปี นับจากวันที่งานวิจัยนี้เสร็จสิ้น

6. ผู้วิจัยและผู้ช่วยวิจัยให้ข้อมูลแก่อาสาสมัครวิจัยด้วยตนเอง โดยการชี้แจงและแจ้งวัตถุประสงค์ของการทำวิจัย ขั้นตอนการทำวิจัยอย่างละเอียดและเข้าใจ และมอบ “ข้อมูลสำหรับอาสาสมัครวิจัย” ที่สมัครใจเพื่อยินยอมในการทำวิจัยครั้งนี้

7. การรักษาความลับ เช่น ข้อมูลที่เกี่ยวข้องกับท่านจะเก็บเป็นความลับ หากมีการเสนอผลการวิจัยจะเสนอเป็นภาพรวม ข้อมูลใดที่สามารถระบุถึงตัวท่านได้จะไม่ปรากฏในรายงาน

Ref. code: 25655817320061KEF

8. การศึกษาวิจัยในครั้งนี้มีความเสี่ยงไม่มากเกินกว่าการดำเนินชีวิตประจำวัน

- ผู้วิจัยหรือผู้ช่วยวิจัยจะมอบแบบสอบถาม โดยให้ท่านตอบแบบสอบถามด้วยตนเอง พร้อมการนัดวันที่ผู้วิจัยหรือผู้ช่วยวิจัยมารับแบบสอบถามคืนจากท่าน (ประมาณ 1 สัปดาห์ หลังจากท่านได้รับแบบสอบถาม) โดยไม่ต้องส่งแบบสอบถามคืนผู้วิจัยหรือผู้ช่วยวิจัย

- หากมีความไม่สบายใจในการตอบแบบสอบถาม ท่านสามารถปฏิเสธที่จะเข้าร่วมการวิจัย หรือขอถอนตัวจากการวิจัยโดยปฏิเสธการตอบแบบสอบถาม หรือไม่ตอบคำถามข้อนั้นได้

- ท่านจะไม่ได้รับค่าตอบแทน ค่าเสียเวลา ค่าเดินทาง หรือเสียค่าใช้จ่ายใดๆ ในการเข้าร่วมโครงการวิจัย

9. การเข้าร่วมงานวิจัยในครั้งนี้อาสาสมัครวิจัยจะได้รับประโยชน์ทั้งทางตรงและทางอ้อม

ผลจากการวิจัยจะทำให้ทราบความชุกและปัจจัยที่เกี่ยวข้องกับกลุ่มอาการที่เกิดขึ้นในที่ทำงาน ทำให้สามารถแนวทางการแก้ปัญหากลุ่มอาการที่เกิดขึ้นในที่ทำงาน เพื่อลดผลกระทบจากอาการที่เกิดขึ้นขณะปฏิบัติงาน เช่น การขาดงาน และเป็นผลดีต่อองค์กร

10. การเข้าร่วมในการวิจัยของท่านเป็นโดย**สมัครใจ** และสามารถ**ปฏิเสธ**ที่จะเข้าร่วมหรือ**ถอนตัว**จากการวิจัยได้ทุกขณะ โดยไม่ต้องให้เหตุผลและไม่สูญเสียประโยชน์ที่พึงได้รับ ซึ่งไม่มีผลกระทบต่อการทำงานแต่อย่างใด

11. หากท่านมีข้อสงสัยให้สอบถามเพิ่มเติมได้โดยสามารถติดต่อผู้วิจัยได้ตลอดเวลา และหากผู้วิจัยมีข้อมูลเพิ่มเติมที่เป็นประโยชน์หรือโทษเกี่ยวกับการวิจัย ผู้วิจัยจะแจ้งให้ท่านทราบอย่างรวดเร็ว เพื่อให้อาสาสมัครวิจัย ทบทวนว่ายังสมัครใจจะอยู่ในงานวิจัยต่อไปหรือไม่

12. หากท่านไม่ได้รับการปฏิบัติตามข้อมูลดังกล่าวสามารถร้องเรียนได้ที่: คณะอนุกรรมการจริยธรรมการวิจัยในคนมหาวิทยาลัยธรรมศาสตร์ ชุดที่ 3 ห้อง 110 ชั้น 1 อาคารปิยชาติ มหาวิทยาลัยธรรมศาสตร์ ศูนย์รังสิต โทรศัพท์ 02-986-9213 ต่อ 7358

APPENDIX F
INFORMED CONSENT FORM (VERSION THAI)

หนังสือแสดงความยินยอมเข้าร่วมการวิจัยของอาสาสมัครวิจัย

ทำที่...
วันที่............เดือน......................พ.ศ. ....

เลขที่ อาสาสมัครวิจัย............................

ข้าพเจ้า ซึ่งได้ลงนามท้ายหนังสือนี้ ขอแสดงความยินยอมเข้าร่วมโครงการวิจัย
ชื่อโครงการวิจัย กลุ่มอาการที่เกิดขึ้นขณะปฏิบัติงานอยู่ในอาคารในโรงพยาบาลมหาวิทยาลัยแห่งหนึ่งในประเทศไทย
ชื่อผู้วิจัย นางสาวพิลาส สว่างสุนทรเวศย์.
ที่อยู่ที่ติดต่อ คณะสาธารณสุขศาสตร์ มหาวิทยาลัยธรรมศาสตร์ ศูนย์รังสิต ปทุมธานี.
โทรศัพท์ 0899920536.

ข้าพเจ้า **ได้รับทราบ**รายละเอียดเกี่ยวกับที่มาและวัตถุประสงค์ในการทำวิจัย รายละเอียดขั้นตอนต่างๆ ที่จะต้องปฏิบัติหรือได้รับการปฏิบัติ ความเสี่ยง/อันตราย และประโยชน์ซึ่งจะเกิดขึ้นจากการวิจัยเรื่องนี้ โดยได้อ่านรายละเอียดในเอกสารชี้แจงอาสาสมัครวิจัยโดยตลอด และ**ได้รับคำอธิบาย**จากผู้วิจัยหรือผู้ช่วยวิจัย**จนเข้าใจเป็นอย่างดี**แล้ว

ข้าพเจ้าจึง**สมัครใจ**เข้าร่วมในโครงการวิจัยนี้ ตามที่ระบุไว้ในเอกสารชี้แจงอาสาสมัครวิจัย โดยข้าพเจ้ายินยอมสละเวลา *ตอบแบบสอบถามจำนวน 2 ชุด ชุดที่ 1 แบบสอบถามข้อมูลทั่วไปและลักษณะการทำงาน จำนวน 6 ข้อ ความรู้สึกต่องาน จำนวน 45 ข้อ และกลุ่มอาการที่เกิดขึ้นในที่ทำงานและบ้านในช่วง 3 เดือนล่าสุด จำนวน 5 กลุ่มอาการ ชุดที่ 2 แบบสอบถามคุณลักษณะ จำนวน 57 ข้อ* เมื่อเสร็จสิ้นการวิจัยแล้วข้อมูลที่เกี่ยวข้องกับอาสาสมัครวิจัยทั้งหมด จะถูกทำลายภายใน 2 ปี นับจากวันที่งานวิจัยนี้เสร็จสิ้น

ข้าพเจ้ามีสิทธิ**ถอนตัว**ออกจากการวิจัยเมื่อใดก็ได้ตามความประสงค์ **โดยไม่ต้องแจ้งเหตุผล** ซึ่งการถอนตัวออกจากการวิจัยนั้น จะไม่มีผลกระทบต่อการทำงานของข้าพเจ้าทั้งสิ้น

ข้าพเจ้าได้รับคำรับรองว่า ผู้วิจัยจะปฏิบัติต่อข้าพเจ้าตามข้อมูลที่ระบุไว้ในเอกสารชี้แจงอาสาสมัครวิจัยและข้อมูลใดๆ ที่เกี่ยวข้องกับข้าพเจ้า ผู้วิจัยจะเก็บรักษาเป็นความลับ โดยจะนำเสนอข้อมูลการวิจัยเป็นภาพรวมเท่านั้น ไม่มีข้อมูลใดในการรายงานที่จะนำไปสู่การระบุตัวข้าพเจ้า

Ref. code: 25655817320061KEF

หากข้าพเจ้าไม่ได้รับการปฏิบัติตรงตามที่ได้ระบุไว้ในเอกสารชี้แจงอาสาสมัครวิจัย ข้าพเจ้าสามารถร้องเรียนได้ที่: คณะอนุกรรมการจริยธรรมการวิจัยในคน มหาวิทยาลัยธรรมศาสตร์ ชุดที่ 3 ห้อง 110 ชั้น 1 อาคารปิยชาติ มหาวิทยาลัยธรรมศาสตร์ ศูนย์รังสิต โทรศัพท์ 02-986-9213 ต่อ 7358

ข้าพเจ้าได้ลงลายมือชื่อไว้เป็นสำคัญต่อหน้าพยาน ทั้งนี้ข้าพเจ้าได้รับสำเนาเอกสารข้อมูลสำหรับอาสาสมัครวิจัย และสำเนาหนังสือแสดงความยินยอมเข้าร่วมการวิจัยของอาสาสมัครวิจัยไว้แล้ว

ลงชื่อ.. ลงชื่อ..

(..) (..)

ผู้วิจัยหลัก อาสาสมัครวิจัย

วันที่........../................/........... วันที่........../................/...........

ลงชื่อ.. ลงชื่อ..

(..) (..)

พยาน พยาน

วันที่........../................/........... วันที่........../................/...........

Ref. code: 25655817320061KEF

APPENDIX G

CERTIFICATE OF APPROVAL (THAI VERSION)

บันทึกข้อความ

ส่วนราชการ สำนักงานคณะอนุกรรมการจริยธรรมการวิจัยในคน มธ. ชุดที่ 3 **โทร.** 0 2-986-9813 ต่อ 7358

ที่ อว 67.04.2/(EC3) 262 **วันที่** 24 มีนาคม 2563

เรื่อง แจ้งผลการพิจารณาของคณะอนุกรรมการจริยธรรมการวิจัยในคน มธ. ชุดที่ 3 สาขาวิทยาศาสตร์

เรียน Ms. Pilas Swangsoonthonwes

ตามที่ ท่านได้เสนอโครงร่างการวิจัยเรื่อง "กลุ่มอาการที่เกิดขึ้นขณะปฏิบัติงานอยู่ในอาคารในโรงพยาบาลมหาวิทยาลัยแห่งหนึ่งในประเทศไทย" รหัสโครงร่างการวิจัยที่ 017/2563 เพื่อขอรับการพิจารณาจริยธรรมการวิจัยในคนจากคณะอนุกรรมการจริยธรรมการวิจัยในคน มหาวิทยาลัยธรรมศาสตร์ ชุดที่ 3 สาขาวิทยาศาสตร์ นั้น

บัดนี้ คณะอนุกรรมการฯ ได้พิจารณาอนุมัติให้การรับรองจริยธรรมการวิจัยในคนให้กับโครงการวิจัยของท่านเรียบร้อยแล้ว ทั้งนี้ได้แนบเอกสารใบรับรองการพิจารณามาพร้อมนี้ และข้อกำหนดของการรับรองโครงการวิจัย คือ เมื่อครบระยะเวลา 1 ปี นับจากวันที่ได้รับอนุมัติ ให้ผู้วิจัยส่งรายงานความก้าวหน้าการดำเนินงาน มายังสำนักงานคณะอนุกรรมการจริยธรรมการวิจัยในคน มธ. ชุดที่ 3 สาขาวิทยาศาสตร์ ห้อง 110 อาคารปิยชาติ ชั้น 1 มหาวิทยาลัยธรรมศาสตร์ ศูนย์รังสิต

จึงเรียนมาเพื่อโปรดทราบ และโปรดดำเนินการตามข้อกำหนดดังกล่าวด้วย จักขอบคุณยิ่ง

(รองศาสตราจารย์ ดร.เภสัชกรหญิง จินดา หวังบุญสกุล)
ประธานคณะอนุกรรมการจริยธรรมการวิจัยในคน มธ. ชุดที่ 3 สาขาวิทยาศาสตร์

BIOGRAPHY

Name	Pilas Swangsoonthonwes
Date of Birth	July 2, 1968
Educational Attainment	1990: B.Sc. (Nursing) 2004: B.P.H. (Occupational Health and Safety) 2007: M.P.H. (Industrial Environment Management)
Work Position	Lecturer
Work Experiences	Lecturer in Faculty of Nursing Pathumthani University Lecturer in Faculty of Nursing Western University Auditor Open Source Technology Co.,ltd. Teacher Natnapa School of Health Care Management IPD Nurse Srisiam Hospital IPD Nurse Rajthanee Hospital OPD, ER, OR and LR Nurse Somdetprasangkaraj Hospital

Ref. code: 25655817320061KEF