Heat - an invisible hazard

Perceived effects of the 2019 heatwave on construction workers in the Netherlands

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Lund University Centre for Sustainability Studies

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Abstract

Global climate change has brought more frequent and severe heatwaves which affect all areas of human life. Occupational safety and health of construction workers is one of the most severely affected areas in Asia and Africa, but also Europe. This thesis focuses on the most recent heat wave from summer 2019 and observes its effects on construction workers in the Netherlands, with examples from immigrant and migratory worker. Selected period of this case study is from 24th to 31st July 2019, as the heat wave temperatures peaked in the Netherlands at this time. Data was collected through semi-structured interviews and literature reviews. The main findings were drawn after conducting and analysing semi structured interviews and conducting the literature review and secondary data. The data was studied from an interdisciplinary point of view with usage of climate change, adaptation, and vulnerability theories. The study findings show constructions workers suffered some heat stress symptoms in 2019, and that the most usual are exhaustion, excessive sweating, loss of focus and headaches, which is in accordance with other studies done in high heat. Employers have been found to have taken some measures to protect their employees from the heat, however these measures were not enough to prevent heat stress symptoms. While occupational safety and health is a priority, heat training is still lacking, and heat is not reported as a cause of injuries or illnesses. Finally, a conclusion has been drawn that at present time heat does not cause noticeable financial losses to observed construction workers personally in the Netherlands unlike in Asian and African countries (Kjellstrom, 2015), however this state might change in the future due to climate change. Equally, injuries and illnesses caused by heat are classified (according to type of injury) by ILO (1998) as “Other specified types of injuries” which means that they are reported together with other types making heat invisible as an occupational health and safety hazard in publicly available records.

Keywords: Occupational safety and health, heatwaves, Netherlands, construction, climate vulnerability, climate change

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List of abbreviations

OSH	Occupational safety and health
CI	Construction industry
CW	Construction workers
IAI	Injuries and illnesses
KNMI	The Royal Dutch Meteorological Institute
NL	the Netherlands
FY	Former Yugoslavia
FG	Focus Group
SSI	Semi-structured interviews
DMSAE	The Dutch Ministry of Social Affairs and Employment
NM	Near misses
WCA	Working Conditions Act
WHO	World Health Organization
WMO	World Meteorological Organization
ILO	International Labour Organization
OECD	Organization for Economic Co-Operation and Development
ECSO	European Construction sector Observatory

1. Introduction

Humans spend approximately one third of their adult lives at work, according to human life expectancy projections (Crimmins, 2015) and hours worked by Organization for Economic Co-Operation and Development (OECD) (2020). Hence occupational safety and health (OSH) concept emerged in the European Union (EU) (Gagliardi Marinaccio, Valenti, and Iavicoli 2012). The goal of OSH is to protect both employees and employers from the negative effects of unsafe practices at work. Employees can suffer work-related (WR) injuries and illnesses (IAI), which can be both physical and psychological, due to unsafe practices. Both employees and employers can suffer financial losses caused by loss of productivity, expensive medical treatments, and lawsuits. Finally, health and economy of the entire population within a country are negatively affected if there is a high number of WR IAI (Figure 1).

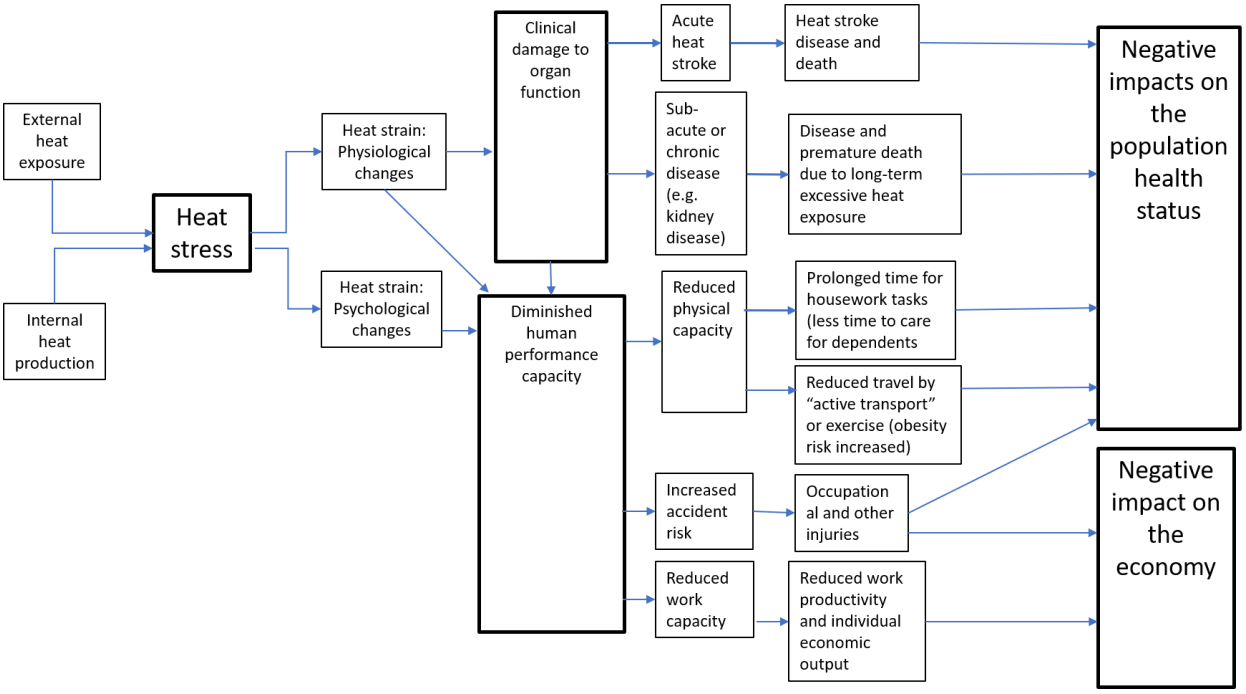

Figure 1. Schematic depiction of pathways from heat exposure to health and economic impacts by Kjellstrom (2015)

Focus of this thesis is on the construction industry (CI), in which OSH regulations are well-developed because it is a "dynamic work environment in which job demands and related hazards are constantly changing" (Sparer, Okechukwu, Manjourides, Herrick, Katz et al., 2015, p.1). CI it is one of the industries most at risk of IAI (Eurostat, 2010) (Figure 2).

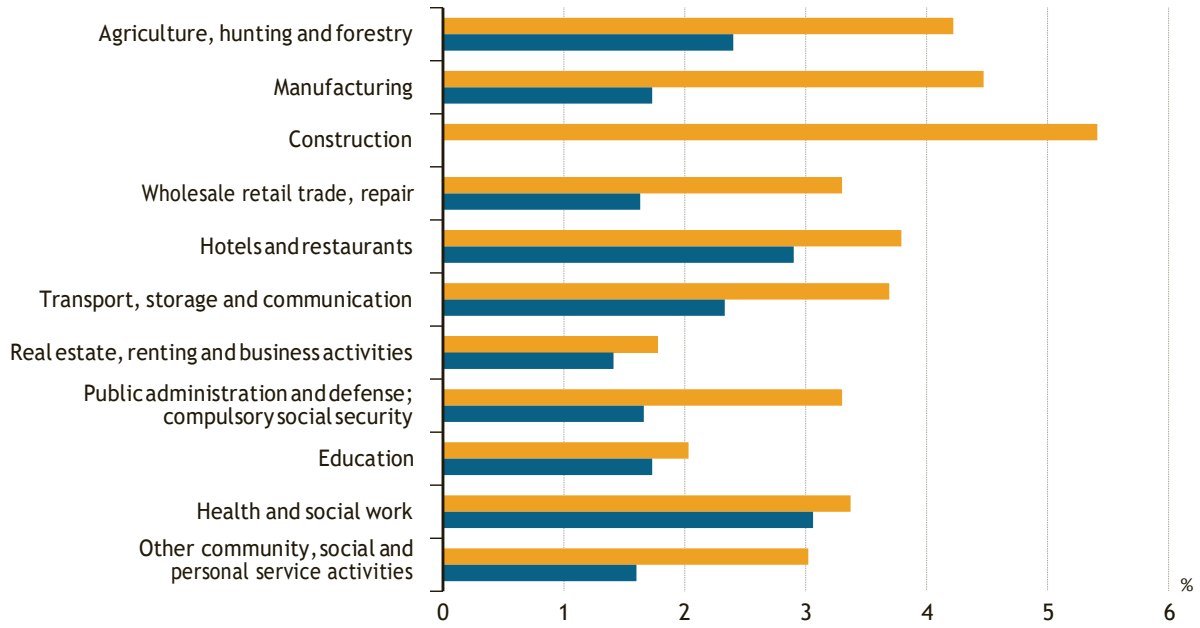

Figure 2. Workers in the EU27 reporting one or more accidental injuries at work or in the course of work in the past 12 months in their main job in different sectors 2007 in percentages (Eurostat, 2010)

Construction workers (CW) are among the most exposed to risk of IAI at work (Eurostat, 2013). Exposure to risk increases once the CI is put in a warming climate context. CW are among the most vulnerable to climate change as heatwaves threaten their well-being amid exposure to the elements while doing physically intensive work (Xiang, Pisaniello and Hansen, 2013; Kjellstrom, 2015). Furthermore, CI consists of a high number of temporary (CBS, 2017), low education, migrant and immigrant workers in EU (Buckley, Zendel, Biggar, Frederiksen, and Wells, 2016; OECD, 2015), who are all among the most risk exposed groups due to restricted access to jobs, manner of employment, language barriers and moving (OECD, 2015).

In the Netherlands (NL) 489. 445 people were employed in the narrow construction sector (excluding architecture, engineering, manufacturing, and real estate) in 2018 adding up to 3% of the population (CBS, 2019). The number of self-employed workers has been on the rise, as well as immigrant workers with temporary contracts (Eurofund, 2020). The five most profitable companies in NL are analysed for this thesis and together they employ around 55 000 workers (TBI, 2019; Royal BAM group, 2019; Heijmans, 2018; Dura Vermeer, 2019; Volker Wessels, 2018).

Heatwaves have become a yearly occurrence in Europe and affect the health of the population (European Environment Agency, 2016). This thesis explores the effects of a 2019 heatwave in the NL on CW and aims

to understand how those effects are manifested, what their consequences are, and how to prevent or reduce those negative effect.

1.1 Research objective

The research objective is to understand the negative effects of 2019 heatwave on CW in NL and suggest a possible course of action to prevent or reduce those effects, by utilizing climate change, vulnerability and adaptation theory, as well as the interdisciplinary approach. To achieve the mentioned goal, three research questions are posed:

1. How did construction worker in the Netherlands experience the 2019 heatwave (e.g. heat stress symptoms, financial losses)?
2. How did construction employers prepare their employees for working during the 2019 heatwave?
3. Which actions could be taken to prevent or reduce heat stress in construction industry in the Netherlands in the future?

1.2 Scope and limitations

This thesis focuses on the effects of a 2019 heatwave on OSH of CW in NL during the period between July 24 and 31, 2019. NL was selected as a case study country because The Royal Netherlands Meteorological Institute (KNMI) (2019) showed it experienced some of the highest temperatures in EU that year. Furthermore, the final week of July is of main interest since this is when the temperature peaked. Only CW were included in this research due to the author's previous experience with and knowledge of OSH on construction sites and their CV. Primary data was collected through semi-structured interviews (SSI) with immigrant and migratory workers from former Yugoslavia (FY) who were actively employed on construction sites in NL during the specified period. Dutch workers were also going to be included in the study through a survey and face to face interviews, however these sources were not utilized due to COVID-19 pandemic, thus limiting the results. A literature review of NL, EU and global heat coping strategies, OSH measures and management techniques was conducted to gain a greater understanding of the current state and offer solutions for the future.

1.3 Relevance to sustainability science

OSH is best viewed from an interdisciplinary point of view, as it is based on engineering, thermophysiology (Lundgren Kownacki, 2018), medicine, and psychology, and is quite complex as such. It combines natural and social sciences, to include both physiological implications of working in heat on human health and social effects such as loss of income and profit on an individual, company and country level which is a fundamental approach of sustainability science (Jerneck, Olsson, Ness, Anderberg, Baier et al., 2011).

Sustainable Development Goals (SDG) fulfilment is one of the main purposes of sustainability science. SDG 8 “Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all” and SDG 3 “ Ensure healthy lives and promote well-being for all at all ages” both benefit from a high quality of OSH management that successfully reduces injuries during extreme weather caused by climate change, such as heatwaves (United Nations, 2016). How this kind of OSH systems contribute to specific targets of SDG 8 and 3 is shown in Table 1.

Table 1. High level of quality OSH systems contribution to SDG 8 and SDG 3 (United Nations, 2016)

Sustainable Development Goal 8 targets	OSH systems contribution
8.2 Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors	Construction is a labour- intensive sector, where economic productivity is closely related to workers ability to perform work effectively and efficiently, which can only be done if the working environment is safe and healthy from all factors including heat (Xiang, 2013; WHO, 2015, Kjellstrom, 2015)
8.5 By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value	Productive employment is the same as above. Decent work includes a safe and healthy working environment as well as adequate care if an injury or illness does occur, which applies to issues caused by heat (United Nations, 2016)
8.8 Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment	The same as above. Equally, construction workers are often migrant workers who are more vulnerable, and who can be equally well protected in a well-developed OSH system (Buckley et al., 2016)

Sustainable Development Goal 3 targets	OSH systems contribution
3.4 By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being 3.4.1 Mortality rate attributed to cardiovascular disease, cancer, diabetes or chronic respiratory disease	Causes of mortality mentioned in this target and indicator are affected working in heat, among other factors. Protection from heat can help reduce the mortality rate caused by mentioned diseases (Statistics Netherlands (CBS), 2019)
3.6 By 2020, halve the number of global deaths and injuries from road traffic accidents	Injuries occulting while traveling to and from work are reported as work- related injuries and measures taken to protect employees from heat effects during traveling for work and working can help reduce traffic accidents and their consequences (ILO, 1998)
3.D Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks	Including heat in OSH official training will make it possible to notice effect heat has on workers and make heat a more visible health risk

2. Background: occupational safety and health, the construction sector, and heatwaves

An overview of OSH is given in the first section of this chapter, followed by important OSH definitions and terms, an overview of the construction sector in NL, heatwaves and their effect on human physiology in, and finally their effects on CW's physical and mental health.

2.1 Occupational safety and health overview

The International Labour Office (ILO) defines OSH as the "discipline dealing with the prevention of work-related injuries and diseases as well as the protection and promotion of the health of workers. It aims at the improvement of working conditions and environment. Members of many different occupations contribute to occupational safety, occupational health, occupational hygiene and improvement of the working environment" (ILO, 1998, p.22).

In addition, OSH is a legal matter: "The competent authority should, in consultation with the most representative organizations of employers and workers, formulate a comprehensive national policy on occupational health in general, and on workers' health surveillance in particular" (ILO, 1998, p.22). It is a part of every country's labour law and employers are bound to provide safe and healthy working environments and risk assessments for each working position they offer, as well as provide OSH training for their employees before they commence work (The Dutch Ministry of Social Affairs and Employment, 1997). Equally, employees are bound to follow all OSH regulations and rules set by the employer.

In NL, The Dutch Ministry of Social Affairs and Employment (DMSAE), more specifically Inspectorate SZW (ISZW) is the competent authority that monitors OSH. ISZW "works for fair, healthy and safe working conditions and socio-economic security for everyone. The ISZW checks if employers and employees comply with the various laws, decrees and regulations in the field of labour" (ISZW, 2019, p.3). Its role concerning OSH is to supervise compliance with regulations of the Working Conditions Act (WCA) and the Working Hours Act, which promote safe and healthy working conditions, working hours and rest breaks for employees, and the Major Accidents Risks Decree and the Supplementary Risk Inventory and Evaluation which aim to reduce the risks for employees and the environment due to hazardous substances (ISZW, 2019). Employers are legally obligated to report major accidents to the ISZW and this is regulated

under the WCA and work-related accidents that result in a fatality, permanent injury or hospitalization are to be reported (ISZW, 2018).

2.2 Occupational safety and health terms and definitions

When analysing OSH it is important to define certain concepts. “Occupational accident” is an occurrence arising out of or in the course of work which results in: (a) fatal occupational injury; (b) non-fatal occupational injury (ILO, 1998). Occupational accidents can be split into injuries and illnesses, which can be fatal or non-fatal. An occupational IAI is an injury/disease “contracted as a result of an exposure to risk factors arising from work activity” (ILO, 2002, p.1).

Non-fatal IAI are those where an affected person did not lose their life, and these can be split into subcategories. Injuries can be categorised according to the type of injury according to ILO (1998) and both are shown in Textbox 1.

Textbox 1. Reportable injury categories and injury type classification (ILO, 2012; ILO Encyclopaedia, 2011; ILO 1998)

Reportable injury categories

- **First aid** is an “immediate care given to victims of accidents before trained medical workers arrive. Its goal is to stop and, if possible, reverse harm. It involves rapid and simple measures such as clearing the air passageway, applying pressure to bleeding wounds or dousing chemical burns to eyes or skin.” (ILO Encyclopaedia, 2011, paragraph 1). In the OSH system an IAI will only be reported as first aid if the affected person did not need to visit a medical professional and receive therapy.
- When a medical professional and therapy are needed, but no days off work were recommended, that is reported as **medical treatment** (University of Wisconsin System, 2020).
- “**Days lost** due to temporary incapacity refers to the total number of calendar days during which those persons temporarily incapacitated were unable to work, excluding the day of the accident, up to a maximum of one year. Temporary absences from work of less than one day for medical treatment are not included” (ILO, 2012).
- **Restricted work** refers to days during which workers carry out lighter duties than normal, or when there is a complete re-assignment of work due to IAI (ILO, 1998).
- **Irreversible** injuries/illnesses refer to traumatic amputation or incurable chronic conditions obtained due to working conditions (ILO, 1998).

Injury types

- Superficial injuries and open wounds
- Fractures
- Dislocations, sprains, and strains traumatic amputations
- Burns, corrosions, scalds, frostbite (thermal)
- Acute poisonings and infections
- Other specified types of injuries
- Concussion and internal injuries

Interview respondents for this research were presented with mentioned categories. However, those are not the only categories available. According to ILO (2012), the variety of possible sources of data on occupational injuries hinders the comparability of the data across sources, since each provides information on different specific concepts.

Furthermore, there is an additional category which is crucial for this study: near misses (NM). NM are unplanned events which did not result in injury, illness, or damage but had the potential to do so (Jones, 1999). According to ILO (2015) they are often overlooked, but important leading indicator of OSH. They show areas for improvement, and potential future accidents for the OSH system if they are monitored adequately. Perttula (2016) views them as a free lesson which allows for learning how to prevent accidents from occurring.

2.3 The construction sector in the Netherlands

According to the European Construction sector Observatory (ECSO) (2019) the Dutch construction market numbered 273.136 construction enterprises in 2018, where the narrow construction sub-sector (only construction, excluding architecture, engineering, manufacturing and real estate) accounted for 69,2% of the total firms (ECSO, 2019). The broad construction sectors share of gross value added to the GDP from it was 10,8% in 2018 (ECSO, 2019). Furthermore, labour productivity is among the highest in the EU and it has been on the rise since 2010 in NL (ECSO, 2019). According to ECSO (2019) the productivity of the narrow construction sub-sector is stable in its productivity.

Most of narrow construction sector employees in 2018 had full- time employment (336.400 employees), 127.000 were self-employed and 69.100 part-time (ECSO, 2019). Number of part- and full-time employees has been decreasing since 2010, while self-employment increased. That is an issue in NL, since social protection and working conditions are more restrained for self- employed (ECSO, 2019) and it allows for employers to hire such workers to avoid making social security contributions (Eurofund, 2020). Being self-employed, these workers receive no salary during vacations and during any period they are not being productive. Because of that the country's pension fund for the building industry announced plans for providing a specialized pension scheme for self-employed masses (ECSO, 2019) and a law was proposed in 2019 which entitles these workers to a minimum wage with a goal to ensure they can contribute to the building up of the society as well as have equal employment relationships (Eurofund, 2020).

2.4 Netherlands temperature statistics

According to the Royal Netherlands Metrological Institute (KNMI), long term average temperature in the NL has been 10,1°C since 2011 (KNMI, 2011), 9,8 °C between 2001 and 2011 and 9,4 °C prior to 2001 (KNMI, 2001). Those temperatures were shown against the highest measured and the average temperatures (Figure 3).

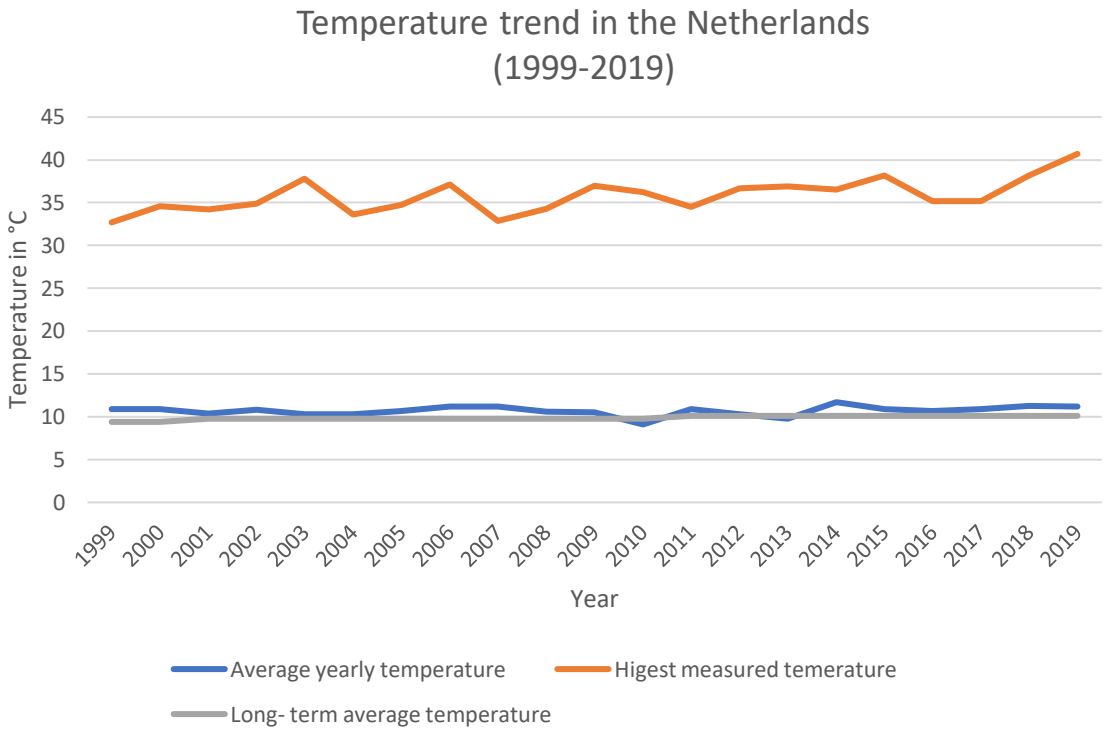

Figure 3. Temperature trend in the Netherlands (1999-2019) (KNMI, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019)

The average yearly temperature has mostly been higher than the long-term average, and stable. The highest yearly average temperature was measured in 2014 at a hight of 11,7 °C compared to 10,1 °C long term average. The highest measured temperature has been fluctuating; however, a rising trend can be noticed. The year with the highest measured temperature was 2019 with 40,7 °C. Finally, the long-term average temperature has been increasing in 10-year intervals since 2001 (Figure 3).

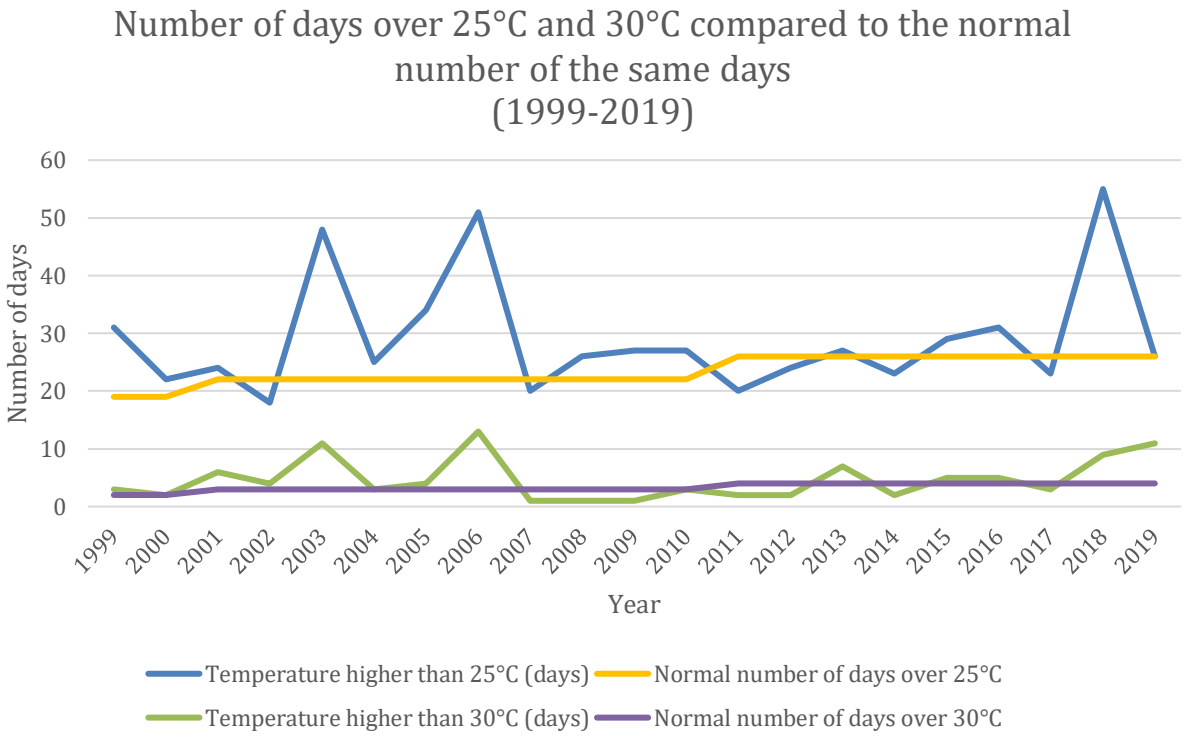

Figure 4. Number of days over 25°C and 30°C compared to the normal number (1999-2019) (KNMI, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019)

The number of summer days (over 25°C) has shown an increasing trend since 2011 while the number of tropical days (over 30°C) has been changing over the years, but peaked in years with strong heatwaves which were 2003, 2006 and 2019 (Figure 4).

2.5 Heatwaves

The definition of a heatwave used in this thesis, is the one used by the World Metrological Organization (WMO; 2018), which states that a heatwave is a "period of unusually hot and dry or hot and humid weather that have a subtle onset and cessation, a duration of at least two to three days and a discernible impact on human activities" (WMO, 2018, p.3). According to the WMO (2018), heatwaves should be characterized by magnitude, duration, extent, and severity aspects. Magnitude is defined as departure from the normal and reflects the climatological extremity of an event. Duration is the time during which the temperature was elevated, and extent is the geographical area which was affected. Severity refers to potential damages of the event. These characteristics are used to describe and understand heatwaves, as shown in Table 2.

Table 2. Heatwave characteristics (WMO, 2018, p.10)

Characteristic	Measuring
Magnitude	Peak temperatures and their locations
	Night-time temperatures
	Historical context relative to normal climate and past extremes
Duration	Number of days that have met thresholds
	Number of days that are forecast to potentially meet thresholds
Extent	A localized heatwave occurs when a small region or small number of locations meet or exceed the heatwave threshold
	A widespread heatwave occurs when heatwave thresholds are met or extend across a large region, for example, multiple countries
Severity	Known risks or potential impacts
	Other triggers that are met, such as the Heat Health Watch

Heatwaves have a strong impact on human health and consequently whole societies (McCarty et al., 2019). The autors show that heatwaves are harmful to human health by stating that these periods of high heat have been associated with physiological stress due to high temperatures as well as heat illnesses which have resulted in increased mortality and hospital admissions. A study in NL showed that the heatwave of 2003 increased mortality rates and hospitalizations in the country (Garssen, Harmsen and Beer, 2005).

The World Health Organization (WHO, 2015; n.d.) lists some of the possible direct and indirect effects of heat on human health, as shown in Textbox 2.

Textbox 2. Direct and indirect impacts of heatwaves on human health (WHO, 2015; WHO, n.d.)

Direct impact of heatwaves on human health

- Loss of focus
- Excessive sweating and dehydration
- Respiratory and cardiovascular diseases
- Diabetes
- Heat cramps
- Heat exhaustion
- Heat stroke
- Renal disease

Indirect impact of heatwaves on human health

- Behaviour change
- Faster and wider transmission of disease
- Reduced air quality
- Reduced functioning of health and other services
- Reduced productivity

As seen above, heatwaves have impacts on human health and society alike. Heatwaves are predicted to become even more frequent and intense due to climate change; therefore, their effects on human health can also be expected to become more harmful (IPCC, 2014). They affect vulnerable populations the most (IPCC, 2014) which includes CW (Xiang et al., 2013). Together with agricultural workers and similar outdoor occupations, CW are most exposed to negative heat effects due to the nature of their work (Kjellstrom, Lemke and Venugopal, 2013). Exactly how they are affected is discussed in the following section.

2.6 Heat stress symptoms and construction

A globally warming climate influences workplace condition, as shown previously. “Climate conditions in workplaces are occupational health hazards that need to be taken into account when assessing population vulnerability to climate conditions and climate changes” (Kjellstrom et al., 2013, p.1). Very hot work environments can create thermal stress which human bodies are not ready to cope with (Kjellstrom et al., 2013). With climate change increasing the frequency and intensity of extremely hot weather, providing a safe working environment for outdoor workers is becoming a greater challenge (Xiang et al., 2013).

Xiang et al. (2013) analysed 55 studies from all over the world and found that in 34 studies, workers (both indoor and outdoor) reported experiencing heat strain when temperatures were high. Almost all the outdoor workers included in these studies (90%) reported heat strain. CW were included in 13% of the studies (Xiang et al., 2013).

CW are vulnerable to heat because frequently use machines and power tools, work on heights, and manually handle heavy loads (Xiang et al., 2013). For example, many CW work with liquid asphalt that has a temperature of 90°C, or at elevations of 100 meters (Heijmans, 2016).

Heat strain symptoms that are the most common are dizziness, loss of consciousness, muscle cramps, headache, exhaustion, and excessive sweating (WHO, 2015; Xiang et al., 2013). Consequences of prolonged exposure to heat can be short-term and long-term (WHO, 2015). Short term consequences include an increased body temperature (Xiang et al., 2013; WHO, 2015), heatstroke, heat exhaustion, heat cramps, heat syncope, heat oedema, and heat rush (WHO, 2015). Long term consequences are cardiovascular disease (Xiang et al., 2013; WHO, 2015), chronic kidney disease (Xiang et al., 2013; WHO, 2015; Flouris, Dinas, Ioannou, Nybo, Havenith et al., 2018), pulmonary issues (WHO, 2015) and various mental issues (WHO, 2015; Xiang et al., 2013; Hancock and Vasmatzidis, 2009). Flouris et al. (2018) found that workers exposed to temperatures over 22°C were four times more likely to experience occupational heat strain than those working in lower temperatures. Finally, Xiang et al. (2013) stated that exposure to heat increases the risk of occupational accidents and injuries.

Potential impacts of workplace heat exposure are to some extent underestimated due to the underreporting of heat illnesses (Xiang et.al, 2013), which will be further discussed in following chapters.

3. Theory

This chapter provides and overlook of climate change, vulnerability and adaptation theories and interdisciplinary approach which were chosen for this thesis, as well as how they are connected to the selected case study.

3.1 Climate change, vulnerability, and adaptation

Scientific theory of climate change is widely accepted (IPCC, 2013; Lundgren Kownacki, 2018). Climate change, according to the IPCC (2014, p5), "refers to a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer". Given the state of the climate over the past few decades, climate change adaptation is unavoidable even when the most advanced mitigation measures are used (IPCC, 2014).

Climate change has brought global warming with it. According to the IPCC (2013), the warming of the climate system is evident and supported by data collected over decades. The report observes that every decade since 1850 has been warmer than the previous decade. Long-term climate model simulations have confirmed this statement by showing that the global mean temperature has been increasing since 1951 (IPCC, 2013).

Even though climate change impacts are best observed and understood in natural systems, human systems are affected as well (IPCC, 2014). This means that climate vulnerability (CV) is crucial to address in this context. Focusing on CV is seen as helpful for comprehending cause-effect relationships between climate change and the impact it has on people, economic sectors, and socio-ecological systems (Aguiar et al. 2018; Fritzsche, Schneiderbauer, Bubeck, Kahlenborn, Buth et al., 2014). The IPCC (2014) defines vulnerability as predisposition or degree to be affected. Aguiar et al. (2018) use the same definition as Parry, Canziani, Palutikof, van der Linden, and Hanson (2007), describing it as "the degree to which a system is susceptible to and unable to cope with, adverse effects of climate change, including climate extremes. CV is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity" (Aguiar et al. 2018, p 1). Kelly and Adger (2000) have defined it as the individual's (or social groups') capacity to respond, cope with, recover from

and adapt to external stresses that are placed on either their livelihoods or well-being. As CW are legally bound to follow OSH regulations their capacity to adapt is limited.

Climate change adaptation is the response to climate change and the IPCC (2014) defines it as a process of adjustment to actual or expected climate and its effects. Within human systems, adaptation is aimed at avoiding or reducing the intensity of climate change effects (IPCC, 2014). As such, it includes activities aimed at risks of the current climate, as well as long-term activities, which are both crucial for this case study.

Climate adaptation was selected due to sharp increase in adaptation research, planning, and practice over the last decade (Aguiar et al. 2018). The EU has rapidly adopted climate adaptation policies to reduce its vulnerability to present and future challenges (Aguiar et al. 2018). According to Aguiar et al. (2018) and Smit and Wandel (2006), this was done by minimizing the direct and indirect impacts of climate change and increasing the EU's adaptive capacity. Furthermore, NL has a 2017-2020 national adaptation strategy, which includes heat as a hazard (National Adaptation Strategy Program Team -NASPT, 2020). Multiple activities and actions resulted from it, such as Congress Heat Stress in June 2018, the Guide to local heat plans, the Sun Force Action Plan and the Heat and Loneliness maps for the G40 (2019), Delta Program for Spatial Adaptation, and the establishment of the Consultation Climate adaptation standards (NASPT, 2020). These plans and activities make it visible that heat is being addressed in NL in some areas of human life, and that there is potential for its expansion on construction.

Given the complexity of adaptation research, it has been accepted as an interdisciplinary field (Lundgren Kownacki, 2018). Interdisciplinarity is a crucial part of this research study, as will be discussed in the following chapter.

3.2 Interdisciplinarity

OSH is "an extensive multidisciplinary field, invariably touching on issues related to scientific areas such as medicine – including physiology and toxicology – ergonomics, physics and chemistry, as well as technology, economics, law and other areas specific to various industries and activities" (Alli, 2008, p17). When viewed from the climate change perspective, the case remains as heatwaves are connected to climate, geography, and climate change. It is evident that this case is a mix of natural and social sciences and as such requires an interdisciplinary approach (Lundgren Kownacki, 2018).

Since this is a sustainability science–based study, a definition by Jerneck et al. (2011) supports the choice of interdisciplinarity by stating that sustainability science attempts to rethink interactions across domains and scales such as nature and society, amongst others. Scales used in this thesis are individual CW, whose health and safety are affected by working on construction sites and which become even more affected in extreme weather conditions such as heatwaves; construction employers who are legally obliged to put in places policies and rules to protect employees and pay their salaries in case an IAI does occur; and the country whose economy and entire population health are affected by the number of OSH injuries and illnesses. Choi and Pak's (2006) definition of interdisciplinarity is also useful for this research as it is defined as something which "analyses, synthesizes and harmonizes links between disciplines into a coordinated and coherent whole" (Choi and Pak, 2011, p1).

OSH in various environmental disasters falls under the category of "real life problems", since it affects safety and health of humans, their ability to work and productivity, and Luks and Siebenhüner (2007) support the usage of interdisciplinarity when facing such problems within sustainability. They say that it combines research on the ecological and social components, involving different and numerous forms of knowledge. As such, it invites those seeking to tackle these "real life problems" to cross the boundaries of their own knowledge and work with experts from other disciplines (Stock and Burton, 2011).

According to Klein (1996) there is no one interdisciplinarity, but rather there are several that are used based on the individual project or research (Huutoniemi, Klein, Bruunc, and Hukkinen, 2009). Stock and Burton (2011) define two kinds of interdisciplinarity: the big and the small interdisciplinarity. The authors define the big interdisciplinarity as the link between distant disciplines such as natural and social sciences. As extreme weather occurrence becomes more frequent due to climate change (IPCC, 2014), tackling OSH problems requires input from both natural and social sciences; thus, a "big interdisciplinarity" is applied.

Usage of interdisciplinarity in OSH during heatwaves is supported by multiple previous studies, such as the one done by Lundgren Kownacki (2018) on a case of OSH in high heat in India. The author stresses that the research required the involvement of various disciplines and associated methods, since engineering, and thermophysiology are central to this issue but the knowledge and tools of other disciplines like medicine, engineering and law are required for the OSH discipline to evolve.

3.2.1 Key disciplines in OSH

Thermophysiology affects OSH because the human body can only remain healthy while working in certain temperatures. The average temperature of the healthy human body is approximately 37°C (Hutchison, Ward, Lacroix, Hebert et al. 2008). Conducting physical labour for prolonged periods of time in temperatures higher than 24°C is harmful to human health (ILO, 2019.). Once the environmental temperature increases, the temperature of the body rises as well. In order to restore its heat balance, the body increases blood flow to the skin and initiates sweating, which increases the heartbeat, makes body lose water and leads to heat issues and costs plenty of energy leading to exhaustion (Donaldson, Keatinge and Saunders, 2009). In addition, heat affects the mental performance of humans and can result in confusion or decreased focus (Hancock and Vasmatzidis, 2009). Physiological reactions of the body when exposed to heat have been discussed in Chapter 2. Furthermore, ergonomy is vital for prevention of musculoskeletal injuries and illnesses and strict procedures are followed when lifting and moving heavy objects on a construction site (Alli, 2008). These are the reasons medicine and a biological understanding of human needs is a crucial part of OSH laws and procedures.

Engineering is an equally important part of OSH as tools and machines are made and adapted for humans to use them safely. “Workplace safety and health programs aim at eliminating the unsafe or unhealthy working conditions and dangerous acts which can be done through: engineering control, design of safe work systems to minimize risks, substituting safer materials for hazardous substances, administrative or organizational methods, and use of personal protective equipment” (Alli, 2008, p106).

According to Alli (2008) occupational safety and health standards have been used to mold Labour laws, and vice versa which helps protect employers and employees including their finances, health and safety alike.

3.3 OSH and climate change vulnerability

Climate change is the cause of rising global temperatures and more frequent occurrences of stronger heatwaves, which is why it is used as a starting point for this research. Climate adaptation is used to investigate and suggest possible measures to reduce negative heat effects on CW in NL, since this problem requires fast and effective solutions. CV is used to support the choice of participants for SSI, since immigrant and migratory workers are more vulnerable to climate change than natives, and their sensitivity

or susceptibility to harm is greater as their capacity to adapt is limited (IPCC, 2014). These theories are then used to compare the results of this study to studies done in different parts of the world.

Interdisciplinarity was used to design the research in terms of the questions that will be asked and the data that will be collected. The goal was to understand the connection between HS symptoms, practical measures taken to prevent them, legal documents, financial losses, and potential solutions which can only be done through an interdisciplinary lens.

4. Methodology

First section of this chapter explains the epistemological stance. It is followed by the research design, research execution and methods. Purposes of selected primary data collection methods are explained and followed by the data analysis methods, the ethical considerations and credibility measures taken. Finally, data limitations are elaborated on.

4.1 Epistemological stance

Crotty (1998) stated that epistemology is a way to explain how we know what we know. The epistemological stance in this thesis is constructivism. Crotty (1998) describes it as a view of human knowledge where there is no objective truth. Instead the truth comes into and out of existence by humans engaging with the realities of the world around them. This means that different concepts can be interpreted differently depending on the context, different people can face the same issues and need different solutions for them, the same person can approach the same situation in different manners at different times. There is no one singular truth and everything depends on the context and the point of view.

4.2 Research Design

The complexity of this topic and usage of sustainability science approach and interdisciplinary view requires both qualitative and quantitative data types. Omitting one of the data types deprives the research of either social or natural aspects of the problem while the goal of the research is to understand them both. For this reason, as well as literature and previous research support, the “mixed method” was

chosen. Finally, the case study was chosen to allow for an exploration of specific locations and dates and to define a target group with the highest possibility of controlling the variables.

4.2.1 Research design and execution

The initial research design of this study, with dates for each planned activity, its purpose, the status of each activity and additional explanations is presented in Table 3 below.

Table 3. Planned and executed research

	Dates planned	Purpose	Planned scope	Executed scope	Reason for changes
Literature review	12.21.2019-02.21.2020	Gathering of theoretical and methodological base, quantitative data	Literature and research about OSH, Eurostat, ILO, WHO data on work-related injury numbers	Planned scope + research from location outside of Europe, legal documents, CBS and KNMI data, review ended 04.24.2020	COVID-19
Case selection	01.01.2020-01.05.2020	Setting a system boundary in terms of location and time	France, Germany, NL	NL	France and Germany have shown no interest in this study
Time frame	N/A	Set boundaries	06.01.2020.-08.31.2020	07.24-2020-07.21.2020	KNMI data
Focus Group (FG)	02.02.2020	Understanding of OSH in Western European context	FY construction workers in Sweden	FY construction workers in Sweden	N/A

Survey	02.07.2020-03.27.2020	Colleting quantitative and qualitative data from construction workers	FY construction workers Members of FNV workers union	None	No interest COVID-19
Semi-structured interviews (SSI)	02.27.2020-03.27.2020.	Survey replacement, qualitative and quantitative data collection	50 FY construction workers employed in NL	12 FY construction workers employed in NL	Low interest
Face to face Interviews	03.25.2020-03.31.2020	Qualitative and quantitative data collection from non FNV construction workers	50 Dutch construction workers interviewed on site	None	COVID-19

As Table 3 shows, this research was initially going to include France and Germany while assessing the impacts of the heatwave during all three summer months. However, no target groups indicated interest in this study in these locations. The observed time frame was reduced due KNMI data that showed that the highest temperatures in NL were reached in the last week of July 2019.

The FG discussion was conducted for a better understanding of OSH state and practices in Western Europe and tailor SSI questions accordingly. It was successfully accomplished. The survey was aimed at CW from FY who were employed in NL and worked there during the time frame mentioned above, and members of FNV workers union. Survey was meant to collect their basic data, as well as quantitative data about injuries they suffered at work, qualitative data about their heat experiences and measures they and their employers took to protect them from negative heat effects. The first group showed no interest in filling out a survey. The FNV workers' union was very interested in this study and wanted to share the survey with their construction-employed members. However, by the time all necessary measures were taken for the survey to be shared, the COVID-19 pandemic prevented it.

SSI were planned once FY CW showed no interest in the survey but were open to a conversation. Only 20 interviews were conducted successfully but 8 were not useful for this research due to lack of trustworthiness. None of face to face interviews (with a translator) were carried out due to COVID-19 pandemic and travel bans.

4.3 Research Methods

The methodological approach used in this thesis is a "mixed methods" one. The visual process of selecting data is shown in Figure 5.

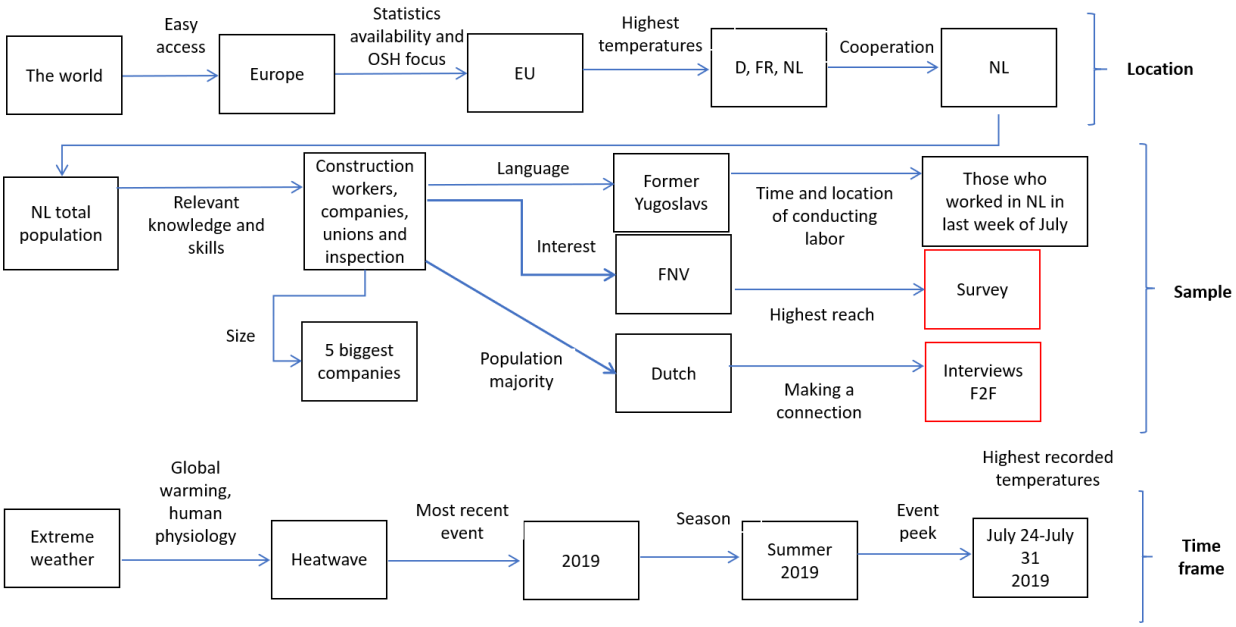

Figure 5. Research design. Boxes in red are steps not taken due to COVID-19 pandemic

As mentioned in the previous section the research methods used are literature review, FG, and SSI. These methods were used to collect quantitative and qualitative data from FY CW, most profitable construction companies and other research about the state of OSH during the heatwave of 2019 in NL. The literature review was used to compare findings with other locations and time frames.

A purposive sampling technique, as well as snowball technique were applied to select the target group. According to Tongco (2007), purposive sampling can be applied to research in several ways. One of the situations when this technique can be applied is when the informants with specific skills or knowledge are of interest (Poggie, 1972). As CW, labour unions, inspection bodies and construction companies have the

highest knowledge of OSH on construction sites, they were selected as sources of information, even though in the end not all were used. Immigrant and migratory workers were chosen as a target group due to their CV, manner of employment, frequent moving and language barriers.

The snowball sampling technique was applied when the participants showed high interest in the research, included their colleagues' experiences when answering questions and referred them for the study.

Finally, this thesis relies more on the literature review and secondary data than primary data due to the COVID-19 pandemic which prevented sufficient primary data collection.

4.4 Focus group discussions and semi structured interviews

The FG discussion lasted for two hours and was conducted in Lund, Sweden on 2nd February 2020. A guide was used to frame the conversation and keep it from taking unwanted turns (APPENDIX A) and interviews (originally in Serbo-Croatian) are transcribed in English (APPENDIX A.1).

The SSI was used to gain insight into the areas of interest defined through the literature review, but also to leave space for the participants to give answers they believe could be of interest based on their experience. A guide of six main questions was prepared for the interviews (APPENDIX B) and they were conducted in Serbo-Croatian language and transcribed in English (APPENDIX B.1).

4.5 Data Analysis

Data on temperature trends in NL is analysed and visualised by using Microsoft Excel (MSE) tool to compare average yearly, highest measured and long-term average temperatures and see how they have been changing since 1999 until 2019. MSE was used to search for a correlation between the percentage of CW injured and both the average yearly temperature and highest measured temperature. However, since no statistically significant correlation could be shown due to the lack of data, those findings were not used. Furthermore, qualitative data is analysed by looking for recurring themes between primary and secondary data. Themes were singled out withing primary and secondary data after which they were compared to find common themes on individual, employer and country levels, connecting it thus to the base of sustainability science approach. Found themes were further compared to medical literature focusing on HS in humans to see weather themes found within secondary and primary data match with it.

4.6 Ethical considerations and credibility

Ethical considerations were applied to protect respondents from any harm while ensuring collected data is relevant and valid.

Participants were given a thorough explanation of who the author is, why she is interested in the subject of OSH in NL during the stated period, and the participants are ensured that their identity is anonymous and their data will not be distributed outside of this research (APPENDIX A.1) prior to the interviews. Each participant has given oral consent before starting to actively participate in the stud. They were encouraged to omit their employers name and if they did it was omitted from the transcript to avoid any backlash. To further protect their identity, respondents are referred to in this research as: occupation, age.

Credibility refers to a guiding model being that decision making processes and problem solving of real life issues can be aided by good science which has not been affected by politics or any other interest but to collect relevant data and portray the truth (Cash, Alcock, Dickson, Eckley et al. 2002). Data was collected independently rather than sought from a company, so that any bias could be avoided. However, keeping in mind that sources of knowledge must be deemed trustworthy (Cash et al. 2002) all sources came from scientific papers and respondents have been checked and some interviews were followed up on to ensure trustworthiness. Only trustworthy participants were included. Trust with participants was built upon a common origin and working experience, while they were assured their data remains private.

4.7 Data limitations

Scope of this study was limited by geographical space, assessed time frame, timing, available funds, interest of relevant bodies in this study and COVID- 19 pandemic.

Geographically, the study is limited to NL and temporally to the period between 24th and 31st July 2019. The amount of primary data was strongly affected by COVID- 19 pandemic since Dutch workers would have been included and different collection methods would have been used. Had there been more time, this data could have been collected after the pandemic, since there was cooperation achieved to do this. Primary data which was successfully collected from respondents was not affected by the pandemic since it was collected before it occurred. The interest for this study was shown only in NL. Data availability made correlations between heat and injuries on construction sites statistically insignificant since it was only

available from 2014 when the reporting system was highly upgraded and made previous data unreliable. Finally, grater funds would have allowed for larger data collection since it would have allowed for monetary compensation for participation in the research and inspired more workers to take part.

5. Results and discussion

Answers to three research questions are presented in this section alongside additional findings of the study. This section presents findings of heat stress symptoms in construction workers, financial losses that were suffered due to heat or not, OSH trainings, corrective and preventive measures taken by both employers and employees and work-related injuries in the Netherlands, with examples from respondent interviews. Findings are compared to other studies from Asian and African countries and discussed. Work-related injury type classifications have been found and presented in order to achieve an understanding of how they are reported and where heat is classified as a source of injuries and illnesses at work. Finally, financial losses caused by heat in construction industry work-related injuries and illnesses have been assessed on the example of FY immigrant workers and compared to financial losses of construction workers from Asia and Africa.

5.1 Working in heat experiences

Work-related injuries and illnesses cause absence from work of varying durations, hence those durations and types of most common injuries in the Netherlands are show in this section alongside heats stress symptoms reported by respondents and observed in the literature and other research. Available data is compared to the literature which focuses on different regions in order to observe similarities and differences. Finally, injury reporting and heats inclusion in it is observed and discussed.

5.1.1 Work-related Injuries in the Netherlands

Work-related injury data for this section was collected from ILO, Eurostat, Statistics Netherlands (CBS), and semi- structured interviews (SSI). Data on the percentage of employees with accidents, number of days of absence due to accidents, mental and unknown injuries from CBS (2020) is shown in Table 4.

Table 4. Work-related injuries by absence length in narrow construction sector in the Netherlands (CBS, 2020)

Year/ Type	Total emplo-yees with an accident (%)	Emplo-yees accident without absence (%)	Emplo-yees accident 1 day or more absen-teeism (%)	Emplo-yees accident 4 days or more absen-teeism (%)	Mental injury (%)	Don't make a distin-ction (%)	Injury un-known (%)	Total (%)
2019	4,5	2,1	2,7	1,9	0,1	0,4	0,3	15,7
2018	3,5	1,8	1,9	1,6	0,3	0,6	0,2	12,3
2017	2,9	1,3	1,7	1,4	0,2	0,3	0,3	10,2
2016	4,0	1,9	2,4	1,6	0,4	0,7	0,3	14,0
2015	4,4	1,8	2,8	1,9	0,1	0,4	0,2	15,1
2014	5,7	2,2	3,2	2,1	0,3	0,6	1,0	18,9

Data concerning types of injuries is available for years from 2014 until 2017 on Eurostat (2020) and indicates that the most common injuries are Dislocations sprains and strains, Wounds and Superficial injuries, Bone fractures and Traumatic amputations (Loss of body parts) respectively. Since the reporting system was upgraded in 2014 in the Netherlands previous data became unusable. Previous data of the amount of days lost due to injury or illness was divided into different categories and could not be compared to the new categories. For data points that kept the same categories as injury types, data from

before 2014 was still unusable since it showed 0 injuries in 2013 in categories that numbered over 8.000 cases already in 2014. Thus, was data made unreliable and it was not used for this thesis.

Evidently, these is a lack of data concerning the narrow construction sector work-related injuries and illnesses prior to 2014. Due to it, no statistically significant correlation could be made between temperature and number of injuries in the Netherlands, even though some correlations were found to be strong and positive. Had there been more data available a strong conclusion could have been made about the correlation between heat and percentage of injured construction workers. Furthermore, heat is not mentioned as a cause of work-related injuries. Keeping in mind the ILO (1998) classification of injuries and that heat is a sub-category, it is possible that is reported under "Injury unknown" or "Don't make a distinction" in Table 4 and within any of the Eurostat (2020) injury types. The invisibility of heat as a cause of work-related injuries and illnesses and as hazard makes the analysis additionally difficult. Therefore, data collection of a larger volume and more detail needs to be conducted in order to draw useful, reliable and statistically significant conclusions which can guide corrective and preventive measures.

Sources like CBS (2018) have stated that the mortality rate increased during heatwaves in the Netherlands, which means that there are fatalities as well as non-fatal issues caused by it. Some respondents have mentioned themselves or their colleagues needing first aids or leaving work early during the heatwave and said that they suspected those incidents happened due to the exposure to heat and conducting of heavy manual labour. Comparing their responses to heat stress symptoms suffered by construction workers in other regions from the literature, it is evident that heat does affect them and can cause injuries and illnesses, but in the case of the Netherlands these injuries need to be better reported in order to draw statistically significant conclusions. Since the respondents come from a vulnerable group, it was interesting to see that, according to ILOSTAT (2020), no injuries were reported for immigrant workers (EU and outside of EU) from 2009 when data starts to 2011, while between 2011 and 2015 there were more injuries reported for immigrants than non-migrants. Outside of EU immigrants have suffered more injuries than others in all years except one.

5.1.2 Exhaustion, excessive sweating, and headaches in construction workers in the Netherlands in 2019

As the climate is changing and temperatures are rising, construction workers are more exposed to and affected by heat (WHO, 2015). The very nature of their work often puts construction workers in prolonged situations in which they are exposed to heat from tools, ambient heat, and direct exposure to the sun, while performing physically demanding labour (Kjellstrom, Kovats, Lloyd, Hold and Tol, 2009). There are many heat illnesses that can result from prolonged exposure to heat stress, and they can cause further injuries to those suffering from them. Respondents indicate having experienced similar heat strain symptoms as the most commonly observed symptoms identified by WHO (WHO; 2015). The most common symptoms expressed by study respondents were exhaustion and excessive sweating, as well as headaches and loss of focus.

Those working with an open flame or working on tasks such as paving suffered the most:

> "I noticed that I was really exhausted in the last week of July 2019 and since I work with open flame most of the time, excessive sweating was a big issue for me. The sweating was making it hard for me to focus when I worked for more than two hours without a break. When I worked longer, I started to feel dizzy and got a headache.", Welder, 28 (Interview 2, 02.28.2020)

> "I was sweating excessively, and it was distracting me from work. Got often dizzy as well and needed much more rest than usual.", Welder, 30 (Interview 2, 02.28.2020)

> "Spreading asphalt is a very hot job without the heat wave, let alone with. I was sweating excessively, and I had headaches every day.", Construction labourer, 20 (Interview 2, 02.28.2020)

However, those who did not conduct work which included the open flame or hot pavement still experienced heat stress symptoms, but at different times:

> "My job is not physical, but a colleague and I had to drive for half an hour to get to the site and it would get really exhausting in the heat." Construction project manager, 38 (Interview 1, 02.27.2020)

> "I didn't have any of the symptoms while working, but I was sweating excessively and found it hard to focus while coming to work." Electrician, 32 (Interview 2, 02.28.2020)

> "I felt exhausted at the end of my days, much more than usual. And it took me some effort to focus on what I am doing and to do it right when it was hot outside." Electrician, 40 (Interview 2, 02.28.2020)

These reports are in line with findings by Flouris et al. (2018) that working in temperatures over 22°C for very intense work and over 25°C for most occupations increases the likelihood of experiencing heat strain. On 25th July 2019, the temperature in the Netherlands reached 40,7°C which is the country record (KNMI, 2019). All study respondents reported suffering some heat strain symptoms, no matter their age, years of experience, employment manner or climates they worked in previously.

Exposure to mentioned temperatures and conducting of manual labour in them has shown that heat stress symptoms can evolve into serious diseases. While there were no such connections to diseases contributed to heat in the Netherlands so far, earlier research had strongly linked high temperatures to kidney disease and respiratory diseases. A significant correlation between heat stress and kidney illnesses has been reported (Tawatsupa, Lim, Kjellstrom, Seubsman, Sleigh et al., 2012), especially for those who worked in heat over 30°C during the summer period. In addition, a study by Soneja, Jiang, Fisher, Romero, Mitchell et al. (2016) determined a connection between high ambient heat and an increase in asthma hospitalizations. With the projected increase in temperature, and more intense prolonged heatwaves occurring due to climate change these issues could arise in the Netherlands in the future (if they are not already occurring but are invisible due to lack of reporting of heat as a cause), possibly before 2030 projections by Kjellstrom (2015), unless protective measures are taken.

Heat affects the physical aspects of humans in various ways, but that is not the only area affected. Heat has been connected to numerous psychological issues such as irritation, aggression and loss of focus, which results in lower cognitive performance and productivity (Hancock and Vasmatzidis, 2009). This supports the loss of focus reported by the participants.

> " Exhaustion, excessive sweating and loss of focus. The sun was so strong it was impossible to think when I didn't wear a helmet, and when I was wearing it I was sweating even more. Bricklayer, 29 (Interview 8, 03.07.2020)

5.1.3 Heat is an invisible hazard in the narrow construction sector

CBS (2020), TNO (2017) and Eurostat's (2020) publicly available reports use similar classifications of work-related injury causes and accident types, however none include heat as a cause. Given that heat as a hazard is difficult to separate from other factors, and that the classification by ILO (1998) does not show it as category on its own but only as a sub-category, it is possible that they have been reported as other injury types, and even more possibly under categories such as "other", "don't make a distinction" and "unknown".

Data for work related narrow construction sector injuries and illnesses divided by type of accident or injury for 2019 was not publicly available by CBS, although a tool "Storybuilder" is available to OSH employees of companies or relevant organizations. This tool makes injury reporting easy and after an injury has been logged, provides analysis options, as well as insight into all the injuries reported trough this system. It cannot have been excluded that some injuries within this system were reported as being caused by heat.

However, one publicly available report has been found during this research which contains heat as a cause of work-related injuries. This is a report from 2018 which was done in cooperation of DMSAE and TNO (the same body which works with DMSAE on adaptation plan implementation). Hooftman, Mars, Janssen, B., de Vroome, Jansenn, B.J.M et al (2018) reported that in 2018 and previously, 0% of work-related narrow construction sector injuries and illnesses were caused by heat. "Storybuilder" is a tool developed by DMSAE which was used to analyses data for the report. It can now be concluded that no injuries were reported as heat related in it either.

For this reason, the scope of injury and mortality causes was boarded with a goal to find out if heat is reported outside of OSH. For example, CBS (2019) has stated on multiple occasion that the death toll increases during high heat. Therefore, their table "Underlying causes of death" was consulted. It provides data up until 2018 in their publicly available section, meaning that only the most recent heatwave effects are missing from it. This table includes all deaths, not only those that were work- or industry-related specific. However, even with the broader scope, heat is not shown as an underlying cause of death either.

A study by Garssen et al. (2005) has reported using the data from CBS to map and understand mortality rates increasing during the 2003 heatwave in the Netherlands. They note: "Unfortunately, this procedure is inappropriate for the study of heat-related mortality, both in the Netherlands and elsewhere. Even in

unusually hot summers, very few deaths are directly or indirectly attributed to these external causes" (Garssen et al, 2005, p1). And thus, heat goes under evaluated again.

Respondents support the results shown above. Most of them have suffered injury prior to the last week of July 2019. This was to be expected, as construction is among sectors with an above average level of sickness absence due to work-related accidents in the Netherlands and 5%, had a work-related accident that resulted in sickness absence (TNO, 2017). This is in agreement with previously mentioned construction industry vulnerability, even outside of extreme weather climate change context. It can be now seen that heatwaves make and already existing vulnerability even worse.

During the last week of July 2019 respondents themselves suffered 1 first aid and 1 lost time while they reported 3 of their colleagues receiving a first aid, medical treatment and lost time respectively. What was most observed in this period were the near misses.

> "I dropped tools a couple of times due to sweat, but they never fell on me or anyone else. They were just what the safety people call near misses". Carpenter, 40 (Interview 5, 03.04.2020)

> "I tripped over my helmet a couple of times while it was hot, and I was taking it off. I never fell or anything, just lost a bit of balance". Bricklayer, 29 (Interview 8, 03.07.2020)

Near misses are a leading indicator and can show possible oversights in safety and health at work. It can be concluded that heat does increase the risk of injury in the Netherlands, based on near misses. Unfortunately, they are not reported, and many lessons are missed due to it.

Finally, it can be concluded that heat is an invisible and unmeasurable source of occupational accidents and near misses. This means that an opportunity to learn from heat caused issues is lost which can lead to an increase in their numbers and produce higher losses for the entire population.

5.2 How the employer prepared construction workers for 2019 heatwave

In all events in which employees may be exposed to hazardous substances or events during their work, the employer is obliged to inform and training them prior to commencing work (DMSAE, 1997). Furthermore, the Working Conditions Decree of 15 January 1997, including provisions in the interest of

health, safety, and welfare in connection with work (DMSAE, 1997) legally obliges employers to assess and react to heat in the working environment through Article 6.1 which concerns temperature. The article 6.1 states:

"1. Taking into account the nature of the activities carried out by the employees and the physical load resulting from them, the temperature at the workplace should not cause damage to the health of the employees.

2. If because of the temperature in the workplace or by unfavourable weather conditions damage can still be caused to the health of the employees, personal protective equipment should be made available. If the personal protective equipment made available cannot prevent the damage to health, the duration of the work should be restricted in its extent or the work be alternated frequently by a temporary stay in a place where there is a temperature as meant in the first paragraph, so that no damage to health is caused." (DMSAE, 1997, pp.87)

Knowing that training is mandatory and that the law equally obliges employers to act once temperatures in the working environment are high, five analysed company activities related to training and preventive measures aimed at heat are observed and answers from the respondents were compared to it.

Construction companies hold plenty of responsibility for the safety of their employees and reporting of injuries alike. Some of the most profitable construction companies' safety policies and the numbers of incidents based on the number of employees were also analysed. Out of five analysed companies, two have made their incident numbers public through their annual reports. One has shown a steady decrease in injury frequency and lost working hours, until 2019 when it spiked. The other did not publicly provide their 2019 data.

5.2.1 Official OSH training

All respondents reported having received basic training, and those who partake in open flame or hot works have received additional training on how to be safe while using these tools.

> "I did (receive training), it was a very thorough session when it came to rules and procedures and signs and such things. But heat was not a part of it". Bricklayer, 34 (Interview 7, 03.05.2020)

> "I for sure did. They do not let us walk onto the site without a signed risk assessment, and you only get that once you have gone through the training and passed a test. We have retraining as well. I am due for mine in a month. Heat was mentioned when hot works with open flame or works like paving were explained. We were told that appropriate personal protective equipment was non-negotiable when it comes to working with heat. And that we should keep well hydrated. But ambient heat was not mentioned, no". Construction labourer, 31 (Interview 5, 03.05.2020)

The five companies analysed in this study all demonstrated high devotion to safety training and voice out how crucial it is for them, in their annual reports.

> "Key achievements during 2018 include the implementation of the Generic Site Safety Instructions. Everyone working in the CI must successfully pass a test on these instructions by 1 April 2019 in order to streamline and standardize minimum knowledge in the area of safety prior to being allowed to enter a building site.", (Volker Wessels, 2018, p.53).

Some companies have gone a step further than what is prescribed by law and introduced a coaching and reporting app which is available to all their employees:

> "Safety-related awareness has improved considerably since the introduction of GO! APP.", project manager (Heijmans, 2015, A safety program with attitude, paragraph 5)

These statements show that employees on construction sites are adequately trained, since everyone receives basic training, while those working on specific jobs receive additional training tailored for the task they are completing. However, ambient heat is not a part of any of these trainings. As a result, workers are unaware of heat stress symptoms and are unable to react to them accordingly, which puts them at a higher risk of injury and illness. Therefore, construction workers need to be made aware of the effects of heat on them and thought how to recognize them, as well as how to react as a part of backs OSH training.

5.2.2 Preventive and corrective measures during the heatwave 2019 in the narrow construction sector in the Netherlands

Preventive measures are the safest option when OSH are concerned, but corrective measures can be used to pave a path for the future preventive measures. The most promoted preventive measure aimed at avoiding HS, especially by the WHO is to stay indoors, where it is cooler and shaded. However, this

measure is not applicable to CW even though they are one of the most exposed groups (Xiang et al., 2013; Occupational Safety and Health Administration, n.d.). Occupational Safety and Health Administration (OSHA) (2017) recommends various other measures for indoor and outdoor workers: training workers and supervisors about heat hazards and illness, training workers and supervisors on preventive measures aimed at heat, encouraging timely hydration and regular meals, set up buddy systems, reduce physical demands of the job and if they cannot be avoided change work rest cycles. Additionally, it is recommended by OSHA to monitor weather forecasts and adapt the schedule to it as well as provide cooling areas. Those suggestions are in accordance with preventive and corrective measures the working force in the Netherlands has expressed as most desired.

Intelligence Group's Labour Market Behavioral Research (2019) has included around 4000 working people who are employed in the fields of agriculture, fisheries and horticulture , facility services and cleaning and construction and was done in the second quarter of 2019, prior to that year's heatwave, but after previous 8 heatwaves. Figure 5. shows 5 most desired measures by employees during a heat event in NL. The figure has been made by Statista (2020) and based on Intelligence Group's (2019) findings.

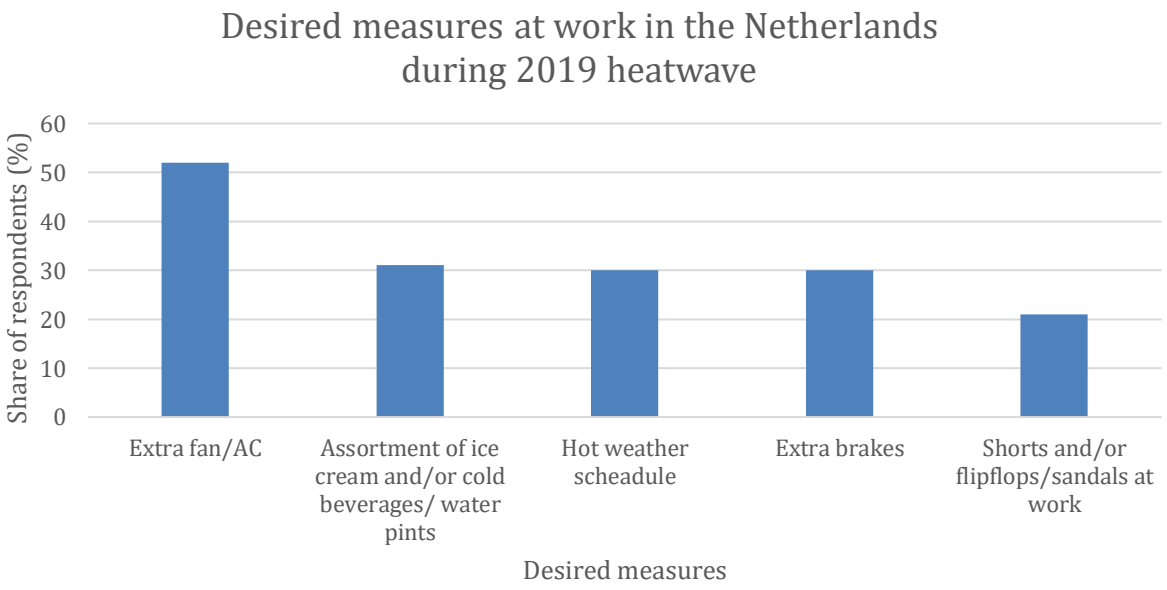

Figure 5. Desired measures at work during heatwaves in NL 2019 (Statista, 2020; Intelligence Group, 2019)

The same research found out that men are more likely to request additional sun protection such as caps, sunscreen, or shade, while women are opting for more brakes and air conditioning. Findings from respondents are supporting this:

> “I was able to move the shifts a bit so that we started earlier in the day, while it wasn't as hot. We also allowed for longer brakes inside where it was cooler”. Site manager, 30 (Interview 3, 03.03.2020)

> “The employer provided free cooled water and coffee on the site and shade. We worked in shade 90% of the time which was helpful. We also got an email with some tips from our direct employer. We were also allowed to wear short sleeved clothing when not using open flame tools. There was also a brake room on the site which was 10 °C cooler than the outside. That was very nice.” Welder, 28 (Interview 2, 02.28.2020)

> “The construction site wasn't modified. We had a brake room which was cooler than the outside and had water, but that was it. We did get an email telling us about the heatwave though. It said to stay hydrated and protect our heads when working outside, especially in the sun.” Carpenter, 27(Interview 3, 03.01.2020)

Unfortunately, many participants reported that there were no measures implemented with an aim to protect them from the heat. All participants who worked for companies or were employed trough agencies reported having received an informational email about the heatwave and with some tips from WHO on how to cope with it, but only three deemed that an actual measure. The email was deemed to not take any action that directly improves the state on the construction site and that it only recommended measures to be taken by the employees themselves. Those respondents who were self- employed at the time noticed tips on how to protect themselves from the heat around the construction site.

> “I could have gotten the same information on the TV; everyone was talking about it. And it was up to us to take those measures” Construction labourer, 31 (Interview 6, 03.05.2020)

> “Absolutely not. First of all, I could have gotten the same information from the internet, from the tv, from the street, anywhere. If they gave us different working hours, longer brakes or something, that would have counted.” Bricklayer, 34 (Interview 7, 03.05.2020)

Findings of Intelligence Group's research (2019) support their opinions with findings that almost 9 in 10 Dutch people think that an employer should take measures in the event of heat, adding up to 87% of the Dutch population. A total of 95% of those employed in the construction industry agreed that measures need to be taken by their employer in the event of heat.

5.2.3 Finances

Work-related injuries and illnesses can cause financial losses to individuals, companies and the country alike, as seen in previous sections, and the same is valid for injuries and illnesses caused by heat. “One result of climate change is a reduced work capacity in heat-exposed jobs and greater difficulty in achieving economic and social development in the countries affected by this somewhat neglected impact of climate change” (Kjellstrom et al., 2009, pp.1).

Research into the costs off work-related injuries and illness from the construction industry in the Netherlands has shown that at this time there are no financial losses for employees as a result of negative heat effects on them at work (Kjellstrom, 2015). They get paid for the time they did not work due to a work-related injury, in accordance to the law. According to DMSAE (2016) work-related sickness absence, disability, and medical care amount to around 8 billion euros a year in NL, which includes all areas of work, not just construction. Here are included the costs of paying salaries to employees who are absent due to work-related causes, disability benefits, and the costs of medical and other care for people with a work-related condition.

In terms of heat as a source of work-related injuries and illnesses, Kjellstrom (2015) has found that there were no costs for the Dutch economy due to it in the past and predicted that the trend will continue up until 2030. Kjellstrom (2015) predicts that there will be a -0,1% of total climate change loss of GDP in the Netherlands due to heat effects on productivity. However, there might still be a possibility of financial productivity loss occurring earlier as a respondent has left work early due to heat stress and still received payment. Kjellstrom (2015) also predicted 0 days of serious heat in the Netherlands (between 32 and 40 °C) up until 2030, which has been proven wrong, since 2019 had 11 days of serious heat in the Netherlands(KNMI, 2019). This suggests that the losses in terms of productivity and finances caused by heat might occur earlier and be higher.

As for the employees themselves, their salaries are ensured by law for the period they are indisposed by the injury, but they might still face the costs of medical treatment that is not covered by their healthcare insurance, or of a loss of salary after being absent from work for one or two years (ILO, 2010; DMSAE ,2016). The same legal protection applies to heat caused injuries and illnesses obtained at work. This is different from heat caused injuries and illnesses in for example: Ghana, Maldives, Philippines, Malaysia and others, where the cost of climate change impacts are predicted to be 5% of the GDP and where

workers don't partake in construction work due to high heat and do not receive payment for the time when they were not productive (Kjellstrom, 2015). In the Netherlands, costs of climate change are predicted do decrease by only 0,1 % of the GDP in 2030 (Kjellstrom, 2015).

There is a period referred to as “Bouwvak vakanties” in NL, which means construction holidays. This is a period in the summer when companies are advised to give holidays to their construction workers due to high holiday season which can affect construction productivity. Even though this holiday is not introduced nor implemented with a goal to protect the working force from negative effects of high heat, it can still be used as a tool to prevent those negative effects if it was organized in accordance with the predicted times of higher temperatures. All respondents said that they believe that would be a good measure taken by their employers.

> “Vacations are always good for safety and health. They help us be more focused and then we can pay more attention to the rules. And of course, not working in high heat is always good for the organism.” Carpenter, 40 (Interview 5, 03.04.2020)

> “It is always good to rest both mentally and physically and come back refreshed. I especially think that this holiday, having occurred during the heatwave, helped the workers who work with open fire.” Construction project manager, 38 (Interview 1, 02.27.2020)

One participant reported that he personally had received days off during this holiday in 2019. He is both a member of a union and has a permanent contract with a company.

> “I didn't work in week 30 and it helped my physical and mental state.” Site manager 30 (Interview 3, 03.03.2020)

However, this participant went to work during the highest heat, so he still experienced HS symptoms. The vacation did help him cope with the symptoms and the mental stress better, since he said that physical rest made him physically fitter and mentally sharper.

The implementation of the construction holiday would not cause financial losses to the employees since the law includes this period as a time which should be covered with a salary (DMSAE, 1997). Only self-employed construction workers would be affected financially, since they would not be earning a salary should they choose to take the recommendation and not partake in construction activities.

> "I think those vacations are useful, but I work during them since I am self- employed, and prefer to work whenever I can, for financial reasons." Bricklayer, 34 (Interview 7, 03.05.2020)

5.3 Future protection from heat

As shown in previous sections, there are already some measures in motion which will help protect OSH of CW from HS. One of those is the recommendation for self-employed workers to be legally entitled to a minimum salary. This measure is not aimed at protecting them from heat, but it will allow them to not work during the "construction holiday" without suffering financial losses. In that way they will not be forced to choose between their health and livelihoods, just like full- time and part-time employees do not. The "construction holiday" is already included in "cao bouwvak" agreements between unions and employers, so those who have contracts are entitled to it and agree with the employer on the exact period when they will use it (Bouwend Nederland, Vereniging Gebouwschil Nederland, Bond van Aannemers van Tegelwerken in Nederland, Vereniging van Steiger, Hoogwerk, Vereniging van Infrabedrijven, et al, 2016). Those employed by agencies and who work in different regions for different companies can still work during the holiday and receive payment, but if they don't work, they will not receive payment (Bouwend Nederland et al., 2016). With the additional protection of self-employed workers, everyone will be entitled to it without financial losses, including those most vulnerable.

However, since these holidays are taken in agreement with the employer and are not aimed at reducing HS, it is possible that some employees will work during high heat. That is why it is crucial to make heat a visible and measurable cause of incidents. Employers need to provide ambient heat training in basic OSH trainings and make employees aware of the symptoms and consequences of HS. Furthermore, incidents need to be analysed into more depth and connected to the ambient temperature so that those caused by heat can be reported as such. When heat is understood and reported, its effects can be measured, and adequate corrective and preventive measures can be designed to reduce its negative effects. The same level of attention needs to be given to NM, even though they are not reported to the authorities. Companies should train employees to differentiate between different causes of NM and report them adequately, so that the company can take effective actions to reduce them and consequentially lower the risk of injury at the construction site.

6. Conclusion

In conclusion, OSH is based, needs and includes knowledge from many varying disciplines in order to achieve its goal to protect humans while working, and as such requires an interdisciplinary approach (Alli, 2008). Therefore, understanding of human physiology, law and engineering among others is needed to improve OSH (Alli, 2008; Lundgren Kownacki, 2018).

Research questions of this thesis were answered through an analysis of available literature, other research done on the same subject but in different regions, five most profitable construction companies' policies and statistics, publicly available databases and focus group and semi- structured interviews. Collected data was analysed, compared, and contrasted to draw conclusions.

Construction workers are found to be a group which is vulnerable to work-relate injuries and illnesses due to the nature of their work and become even more vulnerable during climate change caused heatwaves, as concluded based on the literature review, mainly the International Labour Organization, World Health Organization and other scientific research of the same topic. Migratory and immigrant workers who are included in this study are among the most vulnerable due to their employment status, frequent moving and language barriers (ILO, 2020). Respondents were mostly contractors or agency employees without permanent contract during the period in question, which made their financial situation less stable than of those construction workers with either temporary or permanent contract with companies (Eurofund, 2019).

The answers to three research questions can be summed up as follows:

1) Excessive sweating, exhaustion, headache, and loss of focus were the most common heat stress symptoms experienced by the participants. Some cases of lost times are suspected to be caused by heat, but a larger sample would need to be analysed to draw conclusions. Near misses have been observed, meaning that the risk of injury is higher in high heat, which is in accordance with literature. No financial losses were suffered by the respondents due to heat, and according to literature there will be no losses for employers or the country until 2030.

   Immigrant workers reported more injuries than non-immigrant workers, and immigrants from non-EU countries reported more injuries than those from EU countries. No statistically significant correlation was found between the percentage of employees who suffered injuries and illnesses

and average or highest measured temperature in the Netherlands. The reason was the incompatibility and lack of data prior to 2014.

2) Employers offer mandatory basic OSH training and job specific training to construction workers before they commence work, however ambient heat is not included in the training. Some employers have taken measures to prevent heat stress among their employees by adjusting the work schedule, providing shade, allowing personal protective equipment reduction when it was safe to do so and providing cool refreshments and areas for brakes. However, there were employers which have implanted no measures. All employers sent out an informative email about the heatwave and ways employees can protect themselves from it, but this measure was not deemed as useful by the employees since it was up to them to implement those measures on their own.

3) There is potential to reduce negative heat effects on construction worker by providing a minimum salary to self- employed workers and thus allowing them to not work during high heat and not suffer financial losses.

   Heat is not reported as a cause of any work-related injuries and illnesses in construction (nor outside of it), which makes it an unmeasurable and hence invisible hazard who's true effects on health and finances of individuals and the country are equally hidden.

Based on the answers is visible that there is a lack of awareness and understanding of heat stress symptoms among construction workers, which can be attributed to the lack of ambient heat in OSH mandatory training provided by the employer. There might be financial losses to employer and the country which are caused by heat stress, injuries and illnesses construction workers suffer at work, but they are invisible due to the fact heat is not reported as a cause of injuries, illnesses or any work-related incidents. While the majority of construction workers hold full-time or part- time contracts with construction companies in the Netherlands and thus legally payed when taking a vacation, those who are self- employed have to choose between safety and income (ECSO, 2019; Bouwend Nederland et al., 2016). However, a law has been suggested in the Netherlands to provide self- employed workers with a minimum salary in the future, which can considerably decrease their exposure to heat stress (Eurofund, 2019).

Injury reporting needs to include heat as a cause of injuries and illnesses, which can be done according to the ILO (1998) classification which has a class for heat, and thus make it a visible and measurable hazard.

Finally, near misses which increase the risk of injury and whose number also increases during high heat are not a reportable category in OSH generally. However, they need to be monitored within companies and those caused by heat need to be adequately kept track of and utilized to improve the ability of OSH systems to protect construction workers from negative effects of heat.

In conclusion, heat must be adequately reported, measured, and monitored to observe exactly how it affects migratory, immigrant and native construction workers and what are all the losses that come from it. Only if these steps are taken will the OSH system be able to implement effective and efficient adaptation measures and protect all construction workers from the negative effects of the warming climate. Finally, if heat is reported adequately and construction workers' OSH level increases during heatwaves, fulfilment of Sustainability Development Goals 8 and 3 can be fully achieved.

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8. Appendices

8.1 Appendix A

This is the set of questions used as a guide for the focus group discussion.

Question 1: I would like to know a bit about you first. Where do you come from and how old are you? How long have you been working in construction? In which countries have you worked?

Question 2: What are the differences between Sweden and FY when it comes to occupational safety and health?

Question 3: Have you received official safety and health training before starting work in Sweden, was heat a separate topic? How is safety and health promoted in your workplace?

Question 4: Which measures did your employer take during the heatwave of 2019 to protect you from negative effects of high heat? Which measure did you take yourself?

Question 5: Do you have a permanent or temporary contract? Is there a difference between these two in terms of safety and health training?

8.1.1 Appendix A.1

The focus group met on 2nd of February 2020 in Lund, at noon and discussed the questions from APPENDIX A for approximately one hour. The conversation was taken in Serbo- Croatian language, which is the mother tongue of all the participants and me. I have translated the conversation myself. I refer to myself as “Interviewer” and to the participants in the “Job, age” format, gender was omitted in the referencing format, since all participants are male.

02.02.2020. Lund, Sweden 12:00

Interviewer: Thank you all for taking the time to talk to me today, I highly appreciate it! I would like to start with some introductions. As you know, I am Sanja Kandic, and I am writing a master thesis at Lund University. The topic is Heatwave effects on occupational safety and health at construction sites in the EU. I have experience in occupational safety and health, since I was a SH&E specialist in Serbia, but I don't have an image of occupational safety and health in the EU context. I am hoping that today you could help me understand it better. Of course, your names will not be used or in any way indicated in my research, I will not ask you for the names of companies you work for now nor the ones you worked for in the summer of 2019. What I would like to mention though is your gender, your age and the country you come from. Do you agree with those requests?

All five participants agreed verbally.

Interviewer: Alright, thank you! Let's start. Where do you come from and how old are you? How long have you been working in construction? In which countries have you worked? What is your level of education?

Bricklayer, 35: I come from Serbia and I am 35 years old. I am a construction engineer with a bachelor's degree from University of Novi Sad and I have 10 years of construction experience in various positions. I have started my career in Serbia, as a construction site manager. Five years ago I moved to Sweden and here I work as a bricklayer.

Plumber, 26: I am from Bosnia and Herzegovina and I moved to Sweden after I finished primary school. I completed the courses in framtidsgymnasied and yrkesgymnasiet in Malmö. Started working when I was 20 and I have only worked in Sweden as a plumber.

Carpenter, 24: I am originally from Serbia, but my family moved to the Netherlands when I finished primary school, so I went to high school in the Netherlands. I have worked there for two years as a carpenter, until last year I moved to Sweden. I still work as a carpenter, and I know a lot of guys working as carpenters and plumbers back in Serbia, so even though I have no experiences of my own, I can still contribute some information.

Forklift operator, 36: I am a forklift operator and I come from Serbia as well. My high school is the technical high school, close to the one you went to! I worked in Serbia for eleven years and then moved to France and later to Sweden. I have been working for 18 years but only the last four have been in Sweden.

Bricklayer, 39: I have also stopped after high school, and I am Croatioan. I worked in Croatia first and moved to Germany later. I have 19 years of experience and now I work in Sweden and Denmark, depending on where they send me. I have started as a painter, but now I mostly work as a bricklayer.

Interviewer: You have plenty of experience between you, and you worked in different countries. What are the differences between Sweden and FY when it comes to occupational safety and health and which do you think are important to highlight?

Plumber, 26: As I said before, I have only worked in Sweden but many of my colleagues and friends who have worked in Serbia before, or still work there say that in Sweden personal protective equipment is in much better shape, more reliable and always available. It's a rule that you must wear personal protective equipment while working, or you risk even getting fired, but in Serbia sometimes the employer doesn't make sure it's available, while you can still get fired if you don't wear it. That never happens in Sweden, we get protective equipment at the door when we first start working and then we keep it in our private lockers if we are on a construction site. The rules are a bit less strict and overall different when we go to peoples houses.

Carpenter, 24: I don't know about Serbia, but I completely agree about Sweden. There are people who oversee safety on the site and make sure everyone behaves according to the rules. If you walk somewhere you are not supposed to, or if you remove your personal protective equipment while in the working area,

these guys will give you a warning immediately. Being a carpenter, protective equipment is sometimes all that stands between you and an amputation or even death. They take it very seriously, as do we.

Bricklayer, 35: I agree with Plumber, 26. Personal protective equipment is very important in Sweden and I think it is seen as a workers right, rather than an obligation like in Serbia. The overseeing guys are very strict here. In Serbia they will give you a warning and then go about their business. If they see you "misbehaving" a couple of times then you will get in trouble. Here, you get one warning, they wait for you to gear up properly or move from a restricted area and then keep a closer eye on you for a while. However, I didn't receive official safety training in Sweden, while I did in Serbia.

Forklift Operator, 36: My experience with Serbia and Sweden is similar. That could be because I worked in an international company which has many distribution centres across Europe. Training is taken seriously for forklift operators. No matter how many years of experience you have, you get very detailed training before stepping foot into the distribution centre. A difference I have noticed is that in Serbia we were encouraged to check up on one another, tell our colleagues when they are doing something unsafe, but that is not the case in Sweden. The overseen person does that.

Bricklayer, 39: I worked in Croatia a long time ago, when safety wasn't too popular. I agree with what others have said. The only thing I would add is that training and re-trainings are very timely here and they always have something different in them from the last one, usually based on the most common issue they noticed in safety in the previous year.

Interviewer: Some of you have already mentioned that you received training or not. Have you received official safety and health training before starting work, was heat a separate topic? How is safety and health promoted in your workplace?

Bricklayer, 35: I haven't received official training in Sweden. But there are safety and health policies framed in every office and common spaces. We have those on construction sites as well and there is a safety person present.

Forklift Operator, 36: I have received basic safety training in Sweden, in Malmö, but heat wasn't mentioned. I know that some of my colleagues who do hot works like welding did talk about heat but more in a technical "hold the machine like this so that you don't burn yourself" way. And as Bricklayer, 35 said, the policies and instructions are posted all over the workplace. France was the same.

Other three have all received official training, but heat was not a special topic. None of them are engaged in hot works so they did not receive that type either and don't know anyone who has.

Interviewer: I see there was no official heat training, but were there any other measures taken during the heatwave of 2019? Which measures did your employer take during the heatwave of 2019 to protect you from negative effects of high heat? Which measure did you take yourself?

Plumber, 26: We were allowed to wear shorter work pants, and short sleeved-shirts. We were allowed to take more short breaks during the day. When working inside, we didn't do much except have a water bottle on us at all times and maybe some fruit.

The other 4 agreed that there were no measures taken by their employers, even though temperatures were very high. Given their work stations and the nature of work, they were not allowed to reduce the personal protective equipment in any way. The measures they have taken themselves were to carry a water bottle, refreshments such as fruits, hand fans or wet cloths on their heads, under the helmets.

Interviewer: I wonder whether the contract type has an effect on training you receive and measures that are taken for your safety. Do you have a permanent or temporary contract? Is there a difference between these two in terms of safety and health training?

All 5 participants have permanent contracts in Sweden.

Bricklayer, 35: I first had the temporary contract, got the permanent one later on. There is no difference.

Plumber, 26: I have a permanent contract but some of my colleagues don't and I agree that there is no difference when it comes to training. But I have noticed that if you have a temporary contract, the safety person keeps an eye on you a bit more than on others. Following all the rules in that case and being a model employee can help you get a permanent contract.

Other 3 participants agreed that there was no difference between contract types in other countries either.

Carpenter, 24: I would just like to add that there might be a difference between contractors and regular employees with both contract types in the Netherlands. Contractors who worked with us were not trained with us. Their direct employers are responsible for their training.

Interviewer: One last question. Could you tell me which symptoms of heat stress, if any, you experienced during the 2019 heat-wave? Here is a list of the most common ones, but please do tell if you felt something other than that and thought it was unusual. (I provided a list with the following symptoms: excessive sweating with no relief, loss of focus, muscle cramps, dizziness, nausea and vomiting, fast heart beat, dark urine, confusion, exhaustion and headache)

Bricklayer, 39: I was in Sweden in the summer and it was really very hot. I felt nausea but I never vomited, muscle cramps were quite common and I got exhausted quickly. Of course, excessive sweating was something all of my colleagues suffered from due to the heat and the heavy personal protective equipment. That was very irritating since we were not allowed to take any of it off.

Bricklayer, 35: I was also in Sweden and I agree that the heat was extremely high. My Swedsih colleagues said they don't recall it ever being that hot. Similar case with me, excessive sweating and exhaustion.

Carpenter, 24: For me it was difficult to focus and I can say I was a bit confused. I was forgetting where I left my tools mostly. And sweating.

Plumber, 26: I was lucky to work in people's homes at all times, and everyone has a cooling system now so I did not experience much discomfort while actually working. Coming to work was different, I mostly felt thirsty more often than usual and driving required more focus.

Forklift Operator, 36: I also had focus issues and would get a bit disoriented in space. It would only last for a couple of seconds, but it didn't happen to me before. And excessive sweating of course. I often get muscle cramps, so I cannot say whether those I had in summer were caused by the heat or not.

Interviewer: Thank you all very much for your time and answers.

8.2 Appendix B

These are the questions used as a guide for the semi-structured interviews.

Question 1. Where do you come from and how old are you? What is your education level? How long have you been working in construction? In which countries have you worked?

Question 2. Have you suffered any of the following symptoms between 24th and 31st of July 2019, and if so which ones: excessive sweating with no relief, loss of focus, muscle cramps, dizziness, nausea and vomiting, fast heartbeat, dark urine, confusion, exhaustion and headache.

Question 3. Have you suffered any type of work-related injury before this period (first aid, medical treatment, lost time, irreversible injury)?

Question 4. Have you suffered any type of work-related injury during this period (first aid, medical treatment, lost time, irreversible injury)?

Question 5. Have any of your direct colleagues suffered any type of work-related injury during this period (first aid, medical treatment, lost time, irreversible injury)?

Question 6. Has your employer taken any preventive or corrective measures to protect you from negative effects of working in high heat before or during this period? If yes, which ones? Have you received official safety training from your employer? Was heat addressed as a potential cause of injuries or illnesses?

Question 7. Have you taken any measures to protect yourself from negative effects of heat during this period? If yes, which ones?

Question 8. Have you heard of bouwvak vakanties? If so, do they apply to you? Do you think they might have had a positive effect on occupational safety and health on construction sites during the period in question?

8.2.1 Appendix B.1

The following paragraph was an explanation I offered to all of the participants both through messaging and over the phone to make sure they understand who I am, what the purpose of my thesis is and that their privacy and data will be protected.

“I would like to start with some introductions. As you know, I am Sanja Kandic, and I am writing a master thesis at Lund University. The topic is Heatwave effects on occupational safety and health at construction sites in the EU. I have experience in occupational safety and health, since I was a SH&E specialist in Serbia, but I don't have an image of occupational safety and health in the European Union context. I am hoping that today you could help me understand it better. Of course, your names will not be used or in any way indicated in my research, I will not ask you for the names of companies you work for now nor the ones you worked for in the summer of 2019. What I would like to mention though is your gender, your age and the country you come from. Do you agree with those requests?”

The details of projects, exact origins in terms of cities and towns and the exact migration pattern, as well as the names of companies participants of these interviews work for have been omitted from this research with a goal to ensure their privacy and prevent any backlash.

In this section I refer to myself as an Interviewer and the participants are referred to according to their occupation and age.

Interview 1, 27. February 2020. Done over the phone. Number of participants: 1

Interviewer: Thank you for taking the time to talk to me today! I have some planned questions I would like to ask you, but if there is anything you feel I missed out on asking, please say so. All of your inputs are valuable to my research.

Construction project manager, 38: Of course! I am always happy to help new generations from my bachelor university!

Interviewer: That is good to hear! So, you have started your higher education in the Faculty of Organizational Sciences in Belgrade then? Where did you pursue your education further? And what came after? Where did you work and how much experience do you have on construction sites?

Construction project manager, 38: Yes, I completed a bachelor program in the Faculty of Organizational Sciences, the Operational Management major, I am from Belgrade (Serbia) so I didn't have to move! After that I went to the Faculty of Mechanical Engineering for a master in mechanical engineering. When I graduated from a master's program, 15 years ago, I started working on construction sites as a project assistant and later as an engineer in Serbia. Now I am a 38 year old project manager and I am employed by a Slovenian company which works on projects all over Europe, so I have worked in Finland, Germany, Slovenia, Belgium, and even Alaska. In the summer of 2019 I was in the Netherlands with my whole team, now we are in Denmark. I will be happy to put you in touch with them as well.

Interviewer: That would be amazing, thank you so much! You have plenty of experience and you worked in many countries, do you remember suffering any type of work related injuries in your career, and before the last week of July 2019?

Construction project manager, 38: My job has never been very physical, so I haven't had any work related injuries. I do spend a lot of time on a construction site, all geared up in protective equipment, but as I don't use the tools the only threat for me comes from unsafe moving. And trust me, I take safety moving around the construction site very seriously. However, work related illnesses are more applicable. I have been burned out in the past, some 6 years ago and needed a vacation, so that is one “lost time” for me.

Interviewer: I understand. Burnout is often reported as a work related illness for higher responsibility jobs. What about the last week of July 2019? Have you suffered any injuries or illnesses then?

Construction project manager, 38: Fortunately, I haven't been taking good care of myself since the burnout.

Interviewer: That is really good to hear. In my opinion, when it comes to occupational safety and health our own awareness and responsibility are crucial. But the employer needs to provide as safe of a working environment as they can. When you worked in the Netherlands, did the employer do something to protect you from the heat? And did you receive official safety training?

Construction project manager, 38: The project I worked on in the Netherlands was a bit specific. Safety and health measures were extremely strict. In the part of the project where I mostly worked, we were provided oxygen and carbon measurers, each of us had to have their own, of course. Since the space we worked in was closed and explicitly loud, we wore antiphons. Finally, everyone was obliged to wear a high visibility jacket. Inside was quite cool, 15 °C if I remember right, so heat didn't affect us while we were working. It was unpleasant to walk in and out of that space, but once outside we were allowed to wear short sleeved clothing since we were not endangered outside of that space in any way. My “office” was close to the space and I didnt have to walk through the rest of the construction to get there, as well as two more guys from my team. We were given a free coffee, tea and water machine as well. As for the training, we get official training and retraining from our direct employer, the Slovenian company on a regular basis. In case of the Netherlands project we received additional training before coming to the site, as it was quite a specific project. Heat was not singled out in any way for this training. Actually, I have only received heat related training for the short time I worked as a welder, but that was related to the safe usage of the machine. Atmospheric heat was not a subject of training, but we received an email from our safety team from Slovenia with tips on how to remain safe during the heatwave in 2019.

Interviewer: So you received the email with some tips! Did you apply any of them?

Construction project manager, 38: I did, of course. Working was fine, as I said. However, coming to work was different. A colleague and I had to drive for half an hour to get to the site and it would get really exhausting. I carried a bottle of water with ice cubes with me from home and I would refill it before leaving work, as the safety team advised. I wore thin and loose clothes, but I wanted to look professional so I switched between three combinations, but it really helped.

Interviewer: I noticed something interesting during my research. The bouwvak vakanties, or construction hollidays apply in the Netherlands. In 2019 this holliday occurred during the last week of July, but you were working then. Have you heard of this holliday? Do you think it is beneficial?

Construction project manager, 38: I heard of it, but it did not apply to us. We were contractors, and working on a specific project, so it might apply on to certain construction projects. For those who did have it, I am positive it was beneficial. It is always good to rest both mentally and physically and come back refreshed. I especially think that this holiday, having occurred during the heatwave, helped the workers who work with open fire. Unfortunately, I don't know anyone who this holiday applied to, so I can't help with that.

Interviewer: Thank you so much for your time! The inputs you gave are very useful for my research! That was all I planned on asking. Is there anything you think I overlooked?

Construction project manager, 38: I think you covered all the important things. The only advice I have for you is to talk to guys who work with open flame, I can put you in touch with some of them.

Interviewer: I would really appreciate that! Once again, thank you for the time and advice!

Interview 2, 28. February 2020. Done through Skype. Number of participants: 5

Interviewer: Hello everyone! Thank you for joining this interview on such short notice! I would like to start with some introductions. How old are you, where are you from, what is your level of education, how long you have been working and where have you worked?

Welder, 28: Well I can start. I am 28 years old and I come from Bosnia and Herzegovina. My highest level of completed education is highschool and I started working when I was 19. I started working with Construction project manager 38 two years ago and I worked in the Netherlands, now Denmark with him.

Welder, 30: I am also a welder, I am 30 and I come from Serbia. Also finished high school when I was eighteen and worked on different positions on the construction site. I have been a welder for the past seven years and have worked in Finland, the Netherlands, France and Denmark.

Electrician, 32: I am from Serbia, finished a high school for electricians there and started working when I was 20. I worked in Serbia, Slovenia, the Netherlands and Denmark. I have always worked as an electrician and I am 32.

Electrician, 40: I am also an electrician, 40 years old from Bosnia and Herzegovina. I have been working since I finished high school at 19. Mostly worked in Bosnia and Herzegovina, Slovenia and the Netherlands. This is my first time in Denmark.

Construction labourer, 20: I am from Croatia and the Netherlands project was my first job. I work as a construction labourer which means I do everything from carrying things from one place to another to spreading and rolling asphalt.

Interviewer: Nice to meet you all. As you know, I am interest in the last week of July 2019. Have you experienced any of the symptoms from the list while working in this period?

Welder, 28: I noticed that I was really exhausted in the last week of July 2019 and since I work with open flame most of the time, excessive sweating was a big issue for me. The sweating was making it hard for me to focus when I worked for more than two hours without a break. When I worked longer, I started to feel dizzy and got a headache.

Welder, 30: I agree with Wilder 28. I was sweating excessively, and it was distracting me from work. Got dizzy as well and needed much more rest than usual.

Electrician, 32: I didn't have any of the symptoms while working, but I was sweating excessively and found it hard to focus while coming to work. I mostly work inside where it is cooler.

Electrician, 40: Well I felt exhausted at the end of my days, much more than usual. And it took me some effort to focus on what I am doing and to do it right when it was hot outside.

Construction labourer, 20: Spreading asphalt is a very hot job without the heat wave, let alone with. I was sweating excessively and I had headaches every day.

Interviewer: Have you suffered any work- related injuries before July 2019 and while working in construction?

Welder, 28: I had two medical treatments when I first started working and was inexperienced. I would get burned a little when coming from a brake because I wasn't wearing gloves during the brake.

Welder, 30: I needed a plaster one time, some years ago when I cut myself while making lunch at work. Other than that, and actually work related, none.

Electrician, 32: No, I haven’t had any injuries. I sometimes have sore knees and elbows, but nothing I ever needed to report.

Electrician, 40: Also, just a first aid when I cut myself on a wire, maybe five years ago, I think.

Construction labourer, 20: No, I just started working and have been safe the entire time.

Interviewer: And what about the last week of July 2019? Any injuries for you or your colleagues then?

Welder, 28: In the last week of July 2019 I got too dizzy to work one day. I had a longer lunch break with plenty of water and after that I felt fine but the construction manager said it would be wiser to go home for the day. There were only two working hours left so I wasn't going to miss too much work, and good thing I left because I vomited once I got home. I think they reported it as lost time even though I didn't go to a doctor. As far as I know, only one more guy went home due to the heat.

Interviewer: Did you suffer any financial loss due to the lost time?

Welder, 28: No, I haven't, fortunately!

Interviewer: Good to hear. How about the rest? Any injuries or illnesses which during this time?

Welder, 30: Fortunately, I had no issues that needed any intervention that week. I was just feeling weak and nervous, but nothing drastic.

Electrician, 32: No reportable injuries here either.

Electrician, 40: I have not suffered any injuries or illnesses either, and I only know about Welder 28 leaving a bit early, no one else.

Construction labourer, 20: Still no injuries or any such problems.

Interviewer: What has you employer done to make sure you were protected from the heat while working?

Welder, 28: The employer provided free cooled water and coffee on the site and shade. We worked in shade 90% of the time which was really helpful. We also got an email with some tips from our direct employer. We were also allowed to wear short sleeved clothing when not using open flame tools. But I must say that the protective suits we wear when using open flame are the same in winter and summer. In winter they are fine, but in summer they make it very difficult to work since we sweat so much. There was also a brake room on the site which was 10 °C cooler than the outside. That was very nice. As for the training, I received it from my direct employer. I also got some basic moving training that was specific to the site by the employer who owned the site.

Welder, 30: Well we worked on the same site at the same time on the same job, so I agree with everything Wilder 28 said. Except I don’t think that the email with information was a preventive or corrective measure. It didn’t help in a meaningful way.

Electrician, 32: Free water, and plenty of shade provided. I also had additional brakes and could take them for a bit longer if I needed to. We were allowed to wear lighter clothes as well.

Electrician, 40: I agree with what the others have said. I found the email we received very useful, it showed me that it wasn't just me imagining I was feeling unwell but that everyone could suffer from heat stress and that there are measures we need to take to remain safe. The free water was of course very helpful.

Construction labourer, 20: I also received thorough training by the direct employer and the indirect one before I started using the machine on the site. The training was very useful for me, since I just started. As the guys said, there were free refreshments available, however, I wasn't able to work in the shade most of the time since I was mostly doing the paving work. It would have been much nicer to be in the shade, but I don't see how the site managers could have done that for us as well. I also had a bit of protection from the top of my vehicle and the helmet, but that was just making me even hotter and I sweat more.

Interviewer: What about the measures you took yourself? How did you protect yourself?

Welder, 28: I made sure to have a water bottle with me and to refill it often. When I was not welding, I wore a wet towel around my neck, and I packed a change of light and short clothing for my trip to and from work.

Welder, 30: Yes, water bottle and fresh clothes. I didn't use the wet towel, but now that I think about it, it was a great idea that I will definitely use in the future.

Electrician, 32: Same as the guys, always carried water with me, and never took tea, coffee or juices, to keep my calm and get properly rehydrated.

Electrician, 40: Same as others, personal water bottle, a change of clothes for the way back home. The wet towel is not an option for us electricians, but I will maybe start carrying cooling packs now.

Construction labourer, 20: I also used the wet towel! And the water bottle, of course.

Interviewer: Have you heard of the construction holiday? If you have, do you think it is useful for your work- related safety and health?

Welder, 28: I heard about it yesterday from the Construction project manager, it didn't apply to us I guess since we were contractors, but I think it would be really useful if it applied to everyone, especially us who work with fire. Saving some energy and not getting exhausted between the sun and the fire would be really good for our health.

Welder, 30: I have heard of it before, from friends who work full time in the Netherlands. The way I understood it is that this is a recommended holiday, not an obligation. If it were an obligation it would do wonders for our health and safety for sure, but I am not sure about the economic benefits for us or the employer. We worked normally, so we got a salary and that is always good.

Electrician, 32: Of course, they are useful! Every brake is useful! I had this holiday in 2018 when I worked for a Dutch company on a temporary contract and it truly helped me feel refreshed when I came back.

Electrician, 40: Yes, there are many benefits for safety and health if this holiday is applied. Working in heat is never pleasant, let alone a heat wave. Since this holiday can only occur in summer it would really make a difference for us. The only thing I would be worried about is the salary, like Wilder, 30 said.

Construction labourer, 20: Haven't heard of it before, but I agree with others.

Interviewer: Thank you all for participating!

Interview 3, 1. March 2020. Done over the phone. Number of participants: 1

Interviewer: Thank you for agreeing to this interview! As you know, I have some planned questions, but feel free to add whatever you deem important and which I didn't cover. Shall we begin?

Carpenter, 27: Of course, happy to help! I'm ready.

Interviewer: Great. Could we start with you telling me a bit about yourself? How old are you and where are you from? What is your profession, how long have you been in it and which countries have you been working in? What is the highest level of education you achieved?

Carpenter, 27: Well I am 27 and I come from Serbia but I have been living in the Netherlands for the last five years. I am a carpenter and I finished the woodworking high school in Serbia. I've been working as a carpenter ever since I moved here, but I have done different non construction related jobs prior to that.

Interviewer: Okay, thank you. Now I'm interested in any symptoms of heat stress that you might have experienced during the last week of July 2019. Did you suffer from excessive sweating with no relief, loss of focus, muscle cramps, dizziness, nausea and vomiting, fast heartbeat, dark urine, confusion, exhaustion or headache. Or anything else that was out of the ordinary for you?

Carpenter, 27: Oh, I had muscle cramps, which was out of the ordinary. I am not sure about sweating and exhaustion because I use heavy tools and that is my usual state. I wouldn't be able to say for sure if it was elevated due to heat. But muscle cramps never happened to me before. I work both inside and outside and I noticed they were worse when I was outside for longer.

Interviewer: Yes, heat stress is often difficult to differentiate from anything else unfortunately. What about injuries? Have you suffered any work related injuries or illnesses before or during the last week of July?

Carpenter, 27: I still have all my limbs, fortunately! For carpenters there is no in between, it is either an amputation or nothing. I am always very careful around my tools and I make sure to keep a good posture and maintain my spine in a good condition.

Interviewer: That is the best approach for sure. What about your direct colleagues? Have they had any injuries happen before or during this period?

Carpenter, 27: We had one incident. It wasn't exactly an injury, but he needed to take a whole day off during the last week of July. He is an older guy, around 50, been working for more than 30 years and was used to everything. He fainted, he said he had a strong headache for a while, took a pain med but it didn't work apparently. He went home and skipped the next day as well.

Interviewer: Do you know if there was any financial loss for him due to that?

Carpenter, 27: No, none.

Interviewer: Alright. You already said that you take your own safety seriously, but what about your employer? Have they taken any measures to protect you from the heat in the summer 2019?

Carpenter, 27: Well, there were free refreshments available. There were water fountains around the site, with cold water. Even some fruit in the eating area.

Interviewer: Anything else? Were you offered any information about the heatwave or given any tips about how to protect yourself? Has the construction site been modified in any way to provide more protection from the sun?

Carpenter, 27: The construction site wasn't modified. We had a brake room which was cooler than the outside and had water, but that was it. We did get an email from the agency I am employed trough telling us about the heatwave though. It said to stay hydrated and protect our heads when working outside, especially in the sun.

Interviewer: Did you apply any of those tips?

Carpenter, 27: Of course. I used a wet rag, tied it around my head and only took it off when wearing a helmet. I also wore sunscreen every day. It helped a lot to cool down a bit. Would have been nice if I could have put something cold on my arms as well. Maybe then I could have skipped the cramps.

Interviewer: Why didn't you?

Carpenter, 27: Honestly, I wasn't sure how safe that would be. Us carpenters move our arms all the time and we do it around sharp saws. I didn't have anything I could fix the cooling pad or a wet cloth over my arms safely and I was afraid it would slip and drag me into the saw.

Interviewer: Do you think that personal protective equipment which was more adjusted to working in heat could have made you feel more comfortable?

Carpenter, 27: Of course! I also do woodwork at home, for my house and I made sleeves with pockets for cooling pads. I don't have a cooling system in the shed and it gets really too hot sometimes. Those pads really help! It would be amazing if things like that were allowed on the site.

Interviewer: Did you share your idea with the occupational safety and health team?

Carpenter, 27: I wrote it down in the end of the year survey they gave out. Money would probably be an obstacle there, but we will see!

Interviewer: Fingers crossed! One last question! What do you know about construction holiday weeks?

Carpenter, 27: Oh they are a recommendation for construction companies. They vary for different regions in the Netherlands but are always in the summer months. I have travelled between regions so I worked anyhow.

Interviewer: How do you think it would affect you, if you did take it?

Carpenter, 27: Well since getting actual vacation days in the summer is a bit hard and takes a lot of planning, especially if you are the newest addition to the team as I am...I think it would have a really positive effect on me, on all of us. Knowing that you will have even just five days off and knowing exactly when that will be can do wonders for your mental state. But in my current employment situation I am not sure how it would affect my finances. I don’t have a permanent contract or a temporary one with a company so I might loose some money if I took free time.

Interviewer: What about its effect on safety?

Carpenter, 27: Well I think people would be fresher, less stressed and all, and that would be beneficial for safety, of course. I also think that it is good to not do construction work in the hottest of periods. If just one week in say July or August was off that would be nice. We didn't have any serious incidents now, as I said, but none of us felt good. Would have been nice to rest that week instead and come back fresh the next week.

Interviewer: Thank you so much for your time and input!

Interview 4, 3. March 2020. Done over the phone. Number of participants: 1

Interviewer: Hello, thank you for joining this interview! I'd like to start with a bit about you. How old are you, what is your profession and your level of education? How much experience do you have with construction and where all have you worked?

Site manager, 30: Hi! I am 30 and I went to architecture high school in Serbia, since I am from Serbia. I have been working in construction since I finished high school and I've worked in the Netherlands and Serbia. I have done many construction jobs like bricklaying and wielding, but for the last two years I've been a site manager.

Interviewer: Okay. As you know, I'm doing research into the effects of the heatwave from 2019 on construction workers. Have you suffered any symptoms such as excessive sweating with no relief, loss of focus, muscle cramps, dizziness, nausea and vomiting, fast heart beat, dark urine, confusion, exhaustion and headache during the last week of July, when the temperatures were highest?

Site manager, 30: Oh yes, excessive sweating with no relief, and not just the last week of July, I experienced this throughout the whole of July. Temperatures were really high and I often needed to wear a suit. It was terrible.

Interviewer: Did you suffer any work related injuries before the last week of July 2019? And during?

Site manager, 30: Not during, but yes before. I had medical treatment when I was a bricklayer back in Serbia. A hammer fell on my foot.

Interviewer: How about your colleagues? Any injuries or illnesses in this period?

Site manager, 30: We had 3 cases between the end of June and before the last week of July. All three guys were in their forties. One felt nauseated and I sent him home, the other slashed himself on a saw and needed medical attention and some days off, the last got a small cut which only required a band aid.

Interviewer: Do you know what caused these incidents? And were there financial losses for these guys?

Site manager, 30: The two guys who got cuts said that it was difficult to focus in the heat. They said that they didn't notice where the sharp objects were when the safety guys and I interviewed them. The last one was just out in the sun for too long and didn't hydrate often enough. No financial losses as these were sick leaves.

Interviewer: Did you and your employer take any actions to prevent these incidents from happening in the future?

Site manager, 30: Yes, these incidents showed that more awareness was needed. The safety team sent an email and warned everyone about the heat. I was able to move the shifts a bit so that we started earlier in the day, while it wasn't as hot. We also allowed for longer brakes inside where it was cooler.

Interviewer: You mentioned awareness. Have the construction workers been provided with official safety training before commencing work and was heat addressed as an issue?

Site manager, 30: Of course, all the workers go through the mandatory safety training. I went through it as well. Heat was not a subject.

Interviewer: And did you take any personal measures to protect yourself from the heat?

Site manager, 30: I made sure I was well hydrated at all times. I wore the thinnest suits I had and I cut my hair short so that I felt a bit less hot under the helmet.

Interviewer: What about the construction holiday? Have you applied it?

Site manager, 30: We split ourselves in three groups and each group got a different week off from week 30 to week 33. I didn't work in week 30 and it helped my physical and mental state. Having rested physically made me more fit to cope with stress both physical and mental”

Interviewer: Do you think it was good for people not to work during these times in terms of safety and health?

Site manager, 30: Well we had incidents when people worked during these times and we didn't have them before. There were some after, but those are regular slips and trips in the winter which are only near misses and are not reported in the same way. I think it is good for four older colleagues to skip a week when it is so hot.”

Interviewer: Were there financial consequences of this holiday?

Site manager, 30: No, it belongs to the paid holiday category.

Interviewer: Thank you for all your answers. One last question though. What type of a contract do you have and are you a member of a Union?

Site manager, 30: I have a permanent contract with the company I work for and I am a member of FNV.

Interviewer: Thank you for your inputs!

Interview 5, 4. March 2020. Done over the phone. Number of participants: 1

Interviewer: Hi! Thanks for taking the time to talk to me!

Carpenter, 40: Of course, happy to help.

Interviewer: Grate! Let's start with the basic info about you. How old are you, where do you come from, what is your profession and a level of education? Where have you worked?

Carpenter 40: I come from Croatia, I'm 40 years old and I have finished high school. I am a carpenter and have been working for about twenty years, the last fifteen I spent in the Netherlands.

Interviewer: Great! As you know, I would like to talk about the last week of July 2019 and the heatwave. I wonder if you suffered any of the symptoms of heat stress like excessive sweating with no relief, loss of focus, muscle cramps, dizziness, nausea and vomiting, fast heartbeat, dark urine, confusion, exhaustion and headache during this time.

Carpenter, 40: I did. Excessive sweating and exhaustion. I remember it was so hot my palms were always wet and when I got home, I was too tired to have dinner and could not get enough sleep.

Interviewer: Did you suffer any injuries during or prior to this time? Or your colleagues?

Carpenter, 40: I have had a couple of first aids in my day, minor cuts here and there, nothing a plaster couldn't fix. I didn't have any reportable issues in this period. I haven't heard about my colleagues having issues either.

Interviewer: And not reportable issues?

Carpenter, 40: I dropped tools a couple of times due to sweat, but they never fell on me or anyone else. They were just what the safety people call near misses.

Interviewer: You mentioned near misses. Have you received official safety training before starting work? Was heat mentioned as one of the potential hazards?

Carpenter, 40: Yes, I received the initial safety induction in both companies I worked for. That was a sort of pretraining when we were told about general safety rules, given information like that. Later I had a job specific safety training and got retrained every three years. Heat...no. The guys who do open flame works get that, but not us. We did get a warning from the safety team via email that we should take care during the heatwave.

Interviewer: So you received some information via email. Do you think that was a good measure? Were there any other measures your employer took to keep you safe during the heatwave?

Carpenter, 40: I don't, it changed nothing. Not really, no. We have worked normal hours and had normal break times in cooler spaces. Other than the email, I don't recall anything else.

Interviewer: Have you taken any measures to protect yourself?

Carpenter, 40: I carried a water bottle with me at all times and went to splash water on my face and neck whenever I started to feel too hot.

Interviewer: What about the construction holiday? You worked during the last week of July but did you have any time between week 30 and 34?

Carpenter, 40: I went for a regular vacation in mid-June, but the construction holiday didn’t get allied with the company where I work.

Interviewer: Do you think it would have been beneficial for your health and safety, and your colleagues, if it was applied?

Carpenter, 40: Vacations are always good for safety and health. They help us be more focused and then we can pay more attention to the rules. And of course, not working in high heat is always good for the organism.

Interviewer: Okay. One last question. Are you employed by a company, what type of contract do you have?

Carpenter, 40: I currently have a permanent contract with a company. It is the same one where I was employed trough an agency at in 2019.

Interviewer: Thank you for your time!

Interview 6, 5. March 2020. Done over the phone. Number of participants: 1

Interviewer: Thank you for taking the time to talk to me today! I have some planned questions I would like to ask you, but if there is anything you feel I missed out on asking, please say so. All of your inputs are valuable to my research.

Construction labourer, 31: Happy to help!

Interviewer: Awesome. I'd like to start with some basic questions about you. How old are you, where do you come from, what is your education level, what is your profession and how much experience you have with construction? Which countries have you worked in?

Construction labourer, 31: I am 31 years old and I come from Bosnia and Herzegovina. I have a high school degree and work as a construction labourer. It means that I do various physical tasks on the site, like digging, lifting, carrying, setting up the scaffold, using various tools and so on. I have been working on construction sites since I was 16 and I worked in Bosnia and Herzegovina and the Netherlands.

Interviewer: Now I'd like to ask about how you were feeling during the last week of July 2019 while working or going to and from work. Have you had any symptoms such as excessive sweating with no relief, loss of focus, muscle cramps, dizziness, nausea and vomiting, fast heartbeat, dark urine, confusion, exhaustion and headache?

Construction labourer, 31: I was definitely exhausted and suffered excessive sweating. Those things are pretty common when working on construction but July was something else. Everything was much worse.

Interviewer: Did these symptoms, or any other factor lead to you being injured while working in this period?

Construction labourer, 31: No. There could have been some problems, but fortunately, nothing happened.

Interviewer: What do you mean?

Construction labourer, 31: Well exhaustion is a bad thing to have on a construction site. I was digging in the sun and hit my foot with the shovel. Personal protective equipment here is of a really good quality so it just bounced off my shoe...but I am certain I could have lost a toe or two.

Interviewer: And you think this happened because of the heat? And did you have injuries before?

Construction labourer, 31: Yes. I told you, I have been tired and even exhausted before, but never like this. The only difference was the heat. I have worked in the summer before in Bosnia, but that was different, it is generally warmer there than in the Netherlands and when I was there the temperature would go up gradually, giving us time to adjust. Here one week it was normal, what Bosnians would say chilly for our standards, and then it was burning hot. So yeah, I do think it was the heat. And I had a first aid before.

Interviewer: How about your colleagues? Did they have any injuries or near misses in this time?

Construction labourer, 31: As far as I know, there were no injuries above first aid. But first aids are common, people get scratches and put plasters on them for hygienic reasons. I don't know about near misses, sorry.

Interviewer: That's alright, near misses are hard to notice even for ourselves let alone another. What about safety training? Did you receive any? And was heat mentioned as a hazard?

Construction labourer, 31: Oh I for sure did. They don't let us walk onto the site without a signed risk assessment, and you only get that once you have gone through the training and passed a test. We have retraining as well. I am due for mine in a month. Heat was mentioned when hot works with open flame or works like paving were explained. We were told that appropriate personal protective equipment was non-negotiable when it comes to working with heat. And that we should keep well hydrated. But the atmospheric heat was not mentioned, no.

Interviewer: So training is taken very seriously. What about preventive and corrective actions? Has your employer taken some measures to protect you from the heatwave?

Construction labourer, 31: Uh...no. We worked normal hours with normal brakes and everything.

Interviewer: Have you received any information about the heatwave or some tips about how to deal with it on your own? What did you do to protect yourself?

Construction labourer, 31: I did. There was an email with some info about that. I carried my own water and a wet towel.

Interviewer: You don't think that counts as a measure?

Construction labourer, 31: Honestly, I don't. I could have gotten the same information on the TV, everyone was talking about it. And it was up to us to take those measures.

Interviewer: Fair enough. So, you have been working during the last week of July, but did you have some weeks off around this period, as a part of construction holidays?

Construction labourer, 31: I had a summer vacation in August.

Interviewer: Do you think it would have been beneficial for your safety and health if these hottest weeks were used as a holiday?

Construction labourer, 31: Of course. When you do physical labour, it takes a long time to recover from exhaustion because there is never enough time to be still. If we could stay off the site for a week while the temperatures are highest, it would definitely be good for us!

Interviewer: Finally, are you employed by a company and what type of contract do you have?

Construction labourer, 31: I am. I have a permanent contract now, but in the summer, I had a temporary one with a company.

Interviewer: Thank you so much!

Interview 7, 5. March 2020. Done over the phone. Number of participants: 1

Interviewer: Hello, thanks for agreeing to this interview! Let’s begin with basic information about you like your age, education level, origin, profession and years of experience in construction and countries you worked in.

Bricklayer, 34: I come from Bosnia and Herzegovina and I'm 34 years old, with a high school degree. I work as a bricklayer in the Netherlands and have started as a construction labourer in Bosnia when I was 17.

Interviewer: Good! Now, have you experienced any of the symptoms such as excessive sweating with no relief, loss of focus, muscle cramps, dizziness, nausea and vomiting, fast heartbeat, dark urine, confusion, exhaustion and headache during the last week of July 2019, while working?

Bricklayer 34: I have, yes. Excessive sweating and loss of focus.

Interviewer: What do you think caused it?

Bricklayer, 34: Heat, of course. It hasn't been this hot in the Netherlands since I moved here 15 years ago.

Interviewer: Have those symptoms resulted in any injuries for you? Have your colleagues suffered from injuries in this period?

Bricklayer, 34: No, not for me nor for my colleagues, at least I haven't heard of anyone being injured.

Interviewer: Any near misses?

Bricklayer, 34: I am not sure. As I said, it was very easy to lose focus so it is possible, but I didn't notice anything.

Interviewer: Have you received safety training before starting work and was heat mentioned as a potential hazard?

Bricklayer, 34: I did, a very thorough session when it came to rules and procedures and signs and such things. But heat was not a part of it.

Interviewer: And did your employer take some measures to protect you from the heatwave?

Bricklayer, 34: Work went on normally. There were no changes because of the heatwave.

Interviewer: Did the safety team share any information about the heatwave with you? Gave some tips perhaps?

Bricklayer, 34: I am self- employed, so there was no OSH team. There were some tips around the site, like stay out of the sun and hydrate well.

Interviewer: You don't think that could be seen as a preventive measure?

Bricklayer, 34: Absolutely not. First of all, I could have gotten the same information from the internet, from the tv, from the street, everyone knew about it and everyone was talking about it. If they gave us different working hours, longer brakes or something, that would have counted.

Interviewer: And did you take any measures yourself?

Bricklayer, 34: Yes, I carried my own water and a wet towel around my neck or on the head.

Interviewer: What of construction holiday weeks? Do you know of them?

Bricklayer, 34: Of course, I do. But since I am self- employed, I prefer to work whenever I can, for financial reasons.

Interviewer: Do you think they would have a positive effect on safety and health on construction sites?

Bricklayer, 34: I think they would, for sure. Construction is physically exhausting, combined with heat it becomes extremely difficult. If we didn't work for one- or two-weeks during summer, that would definitely be good for our bodies and mind.

Interviewer: Thank you for your time!

Interview 8, 7. March 2020. Done over the phone. Number of participants: 1

Interviewer: Hi! I would like to start with some basic info about you. Such as your age, education level, origin, profession and years of experience in construction and countries you worked in.

Bricklayer, 29: I am 29, from Serbia. I finished high school and have done various jobs since then, all in Serbia. I started working as a bricklayer 2 years ago in the Netherlands.

Interviewer: Okay. So, the last week of July in 2019 was marked as the hottest during the heatwave. Do you remember feeling any of the symptoms of heat stress such as excessive sweating with no relief, loss of focus, muscle cramps, dizziness, nausea and vomiting, fast heartbeat, dark urine, confusion, exhaustion and headache?

Bricklayer, 29: Exhaustion, excessive sweating and loss of focus. The sun was so strong it was impossible to think when I didn't wear a helmet, and when I was wearing it I was sweating even more.

Interviewer: Did you do something to help yourself feel less of the symptoms?

Bricklayer, 29: I have taken a water bottle with me to work every day.

Interviewer: Did your employer take some measures before or after the final week of July to make it easier for you to work in the heat?

Bricklayer, 29: No. Everything went as it always did.

Interviewer: What about injuries or illnesses, did you suffer any type of work-related illnesses or injuries prior to or during this period?

Bricklayer, 29: I haven't. I am in good shape and take good care of myself.

Interviewer: That is good to hear! Unfortunately, good shape often does not have much to do with safety at work, especially at a construction site where anything could happen. Have you had any near misses?

Bricklayer, 29: What are those?

Interviewer: Those are situations which you found yourself in and which could have had some dangerous outcomes, but did not. For example, someone left a hot wielding tool on the floor while it was still on and you walked past it. It burned your shoes a little, but you were not harmed and you could turn the tool off and put it where it should be.

Bricklayer, 29: I had those. I tripped over my helmet a couple of times while it was hot and I was taking it off. I never fell or anything, just lost a bit of balance.

Interviewer: Have you received official safety training before starting work?

Bricklayer, 29: You mean like if I had a safety class?

Interviewer: Yes. As if a safety person told you about the safety rules, explained the procedures and meaning of certain terms and maybe gave you some printed material before you were allowed to start working.

Bricklayer, 29: There was a class like that and we got pamphlets at the end.

Interviewer: Did you find it useful?

Bricklayer, 29: There was a lot of information and didn't really remember much of it. Besides, there is a safety person always present on the site and they tell us if something is wrong.

Interviewer: What about the construction holiday weeks? Have you heard of them?

Bricklayer, 29: No.

Interviewer: Those are weeks which construction companies can take off during summer if they decide to. It is mostly done because this is the holiday season. Do you think if companies take this time off, the safety and health of construction workers would be improved in the summer months?

Bricklayer, 29: Not working in extreme heat is always good. I think it would be a good idea.

Interviewer: Final question. What type of contract do you have? Are you a member of a workers union?

Bricklayer, 29: I am self-employed and not a member of a union, not yet at least.

Interviewer: Thanks for your time!