

**INTERSECTIONAL IMPACTS OF SEX AND GENDER ON EMPLOYMENT
OUTCOMES IN PATIENTS WITH ATRIAL FIBRILLATION:
A SYSTEMATIC REVIEW AND META-ANALYSIS**

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Abstract

Background

More than 33 million people worldwide suffer from Atrial Fibrillation (AF) (Chugh et al., 2014; Goren et al., 2013). The objective of this systematic review and meta-analysis was to explore the research question: *How does sex and gender impact employment outcomes in adult patients with atrial fibrillation?*

Methods

A systematic search was conducted in accordance with the PRISMA 2020 guidelines using keywords and MeSH terms related to atrial fibrillation, employment, sex and gender. Studies were included if they presented sex or gender-specific outcomes or employment outcomes for adults with AF. Data was presented in forest plots and using I^2 statistics.

Data Synthesis and Analysis

A fixed-effects meta-analysis was conducted using R software. Results were expressed as Odds Ratios (ORs) and 95% confidence intervals (95% CIs). The I^2 statistic was used to assess statistical heterogeneity. Forest plots were generated to represent effect sizes and heterogeneity visually

Results

A total of twenty studies met the inclusion criteria for qualitative synthesis, and eight were included in the quantitative meta-analysis. Pooled data indicated that males with atrial fibrillation (AF) had 24% lower odds of unemployment compared to females (OR = 0.76, 95% CI: 0.65–0.86). Unemployment was associated with a 44% increased risk of AF (OR = 1.44, 95% CI: 1.29–1.59). Shift work was linked to an 11% higher risk of incident AF (OR = 1.11,

95% CI: 1.05–2.17), although heterogeneity was substantial ($I^2 = 90.59\%$). Many studies conflated sex and gender.

Conclusions

The findings from this study suggest that structural inequities tied to sex and gender exacerbate employment challenges and health risks for AF patients. Policies that provide flexible scheduling, caregiving support, and equitable labour conditions may reduce the socioeconomic and cardiovascular burdens associated with AF.

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List of Abbreviations

AF	Atrial Fibrillation
AHRQ	Agency For Healthcare Research and Quality
CINAHL	Cumulative Index to Nursing and Allied Health Literature
HRQOL	Health-Related Quality of Life
MeSH	Medical Subject Headings
NOS	Newcastle Ottawa Quality Assessment Scale
OR	Odds Ratio
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
QOL	Quality of Life
RTW	Return-To-Work

Atrial Fibrillation: The New Cardiovascular Epidemic

Research has suggested that atrial Fibrillation (AF) is the new cardiovascular disease epidemic of the 21st century (Nishaki K Mehta et al., 2021), and the prevalence of AF is expected to double by 2050 (Go et al., 2001). AF is an irregular and often very rapid heart rhythm (Mayo-Clinic, 2024).

Arrhythmia results from irregular electrical activity in the heart's atria, which causes a fast, chaotic rhythm instead of the regular rhythm and pace (Cleveland-Clinic, 2024; Pellman & Sheikh, 2015). It is classified as a tachyarrhythmia, which means a fast heart rate.(Nesheiwat et al., 2023). Arrhythmia may be paroxysmal (less than seven days) or persistent (more than seven days). An irregular heartbeat can lead to turbulent blood flow through the heart and an increased risk of thrombus formation of blood clots, which can ultimately cause a stroke by dislodging a blood clot. (Nesheiwat et al., 2023). Other symptoms, which include palpitations, chest discomfort, shortness of breath, and sudden exhaustion, have a substantial negative impact on the quality of life (QoL) of those suffering from AF (Thrall et al., 2007).

Why is it Important to do this Review?

Research has suggested that sex and gender are critical determinants of health and healthcare. Previous studies across other conditions have shown that gender biases and disparities exist in healthcare, including conditions such as pain management, irritable bowel syndrome, and cardiovascular disease (Hølge-Hazelton & Malterud, 2009; Skuladottir & Halldorsdottir, 2008); with women often being disproportionately affected (Björkman et al., 2014; Dekker et al., 2016; Sliwa et al., 2010). In the context of AF, despite improvements in the last ten years in our knowledge of AF and its treatment and therapeutic strategies, gender disparities in atrial fibrillation still exist (Westerman & Wenger, 2019). For example, several

national and international studies show that different sex and genders have different symptom patterns and treatment management strategies. They reveal that women are more likely to be symptomatic and report lower quality-of-life scores (Dagres et al., 2007; Lee et al., 2018; Piccini et al., 2016; Schnabel et al., 2017) , yet they are less likely to be managed with rhythm control strategy, one of the main treatment approaches for AF (Piccini et al., 2016; Westerman & Wenger, 2019).

There have been growing calls from researchers and healthcare journals to integrate more sex and gender-based analyses into health research (Heidari et al., 2011; Johnson & Beaudet, 2013; Runnels et al., 2014). While progress has been made in recognizing these gaps, there is still much work to be done—especially in examining how social determinants of health, such as employment, interact with sex and gender for AF patients.

Employment and working conditions are also vital components of well-being, and there is strong evidence linking employment to improved health outcomes (Ross & Mirowsky, 1995; Rueda et al., 2012; Van Der Noordt et al., 2014; Waddell, 2006). However, while there is extensive research on the epidemiology of AF (Chugh et al., 2014; Kornej et al., 2020), clinical outcomes (Piccini et al., 2016), and the efficacy of various treatment regimens by sex (Nishaki K. Mehta et al., 2021; Packer et al., 2019; Westerman & Wenger, 2019), there has been considerably less study on the effects of sex and gender on employment outcomes for patients with AF.

By synthesizing existing research on sex and gender and employment outcomes, this research seeks to bridge these gaps in literature. This research is centred around the research question: *How does sex and gender impact employment outcomes in adult patients with atrial fibrillation?* By identifying the barriers patients with AF may face, this thesis attempts to

contribute to a better understanding of the intersection of sex and gender and employment outcomes for researchers, employers and policymakers to support more effective policies and targeted employer support and interventions.

Literature Review

"Historically, women's health was nicknamed 'bikini medicine' because medical practitioners considered the only thing making women biologically different from men to be those body parts that could be covered with a bikini."

(Mauvais-Jarvis et al., 2021, p. 732).

Understanding Sex and Gender

The understanding of sex and gender has grown over time, with scholars and researchers recognizing the distinction between the two concepts (i.e. (Delphy, 1993; Krieger, 2003; Lips, 2020; Unger, 1979)). As this review focuses on the effects of sex and gender on AF, it is essential to clarify the conversations surrounding these terms. In the past, the words sex and gender were frequently used interchangeably. Over time, this understanding has evolved, and many psychologists have now embraced a more specific meaning of the two categories after being inspired by feminist psychologist Rhoda Unger (1979). Sex refers to a person's biological status as male, female, or intersex (Heise et al., 2019; Krieger, 2003; Unger, 1979). Gender encompasses the societal and cultural expectations and roles associated with femininity and masculinity (Heise et al., 2019, p. 2640; Krieger, 2003; Unger, 1979). Early sociologists (West & Zimmerman, 1987) defined gender as the activity of managing situated conduct in terms of normative concepts of attitudes and activities appropriate for one's sex category (West & Zimmerman, 1987, p. 127). The Canadian Institutes of Health Research (CIHR) now defines

gender as the “socially constructed roles, behaviours, expressions and identities of girls, women, boys, men, and gender diverse people” (CIHR, 2023).

Furthermore, the debate and discussion about the relationship between sex and gender continue to evolve. For example, Lips (2020) argued that sex (physical bodies) and gender (cultural expectations of men and women) are inextricably linked and cannot be cleanly separated (Lips, 2020, p. 7). Researchers such as Van Anders (2015) have suggested using "gender/sex" as "an umbrella term for both gender (socialization) and sex (biology, evolution) (Van Anders, 2015, p. 1181).

The essentialist discourse views gender as a fixed independent variable based on biological sex rather than social constructs (Hølge-Hazelton & Malterud, 2009). Essentialist models portray gender as fundamental traits and static stereotypes compared to gender constructivists, who view gender as the daily sociopolitical situations of one’s existence (Bohan, 1993). This essentialist viewpoint argues that men and women differ in ways that are thought to be natural. For example, males are thought of as more powerful and logical; Women are more frail, perceptive, and compassionate (Hølge-Hazelton & Malterud, 2009; Jenks, 1998, p. 151). This viewpoint may lead to oversimplified determinism and static stereotypes, reinforcing gender inequalities in healthcare. (Bohan, 1993; Hølge-Hazelton & Malterud, 2009). Stereotyping based on gender roles relies on cultural assumptions about the characteristics of men and women, which may not reflect the diverse and fluid experiences of gender (Björkman et al., 2014).

A growing body of research further compounds this topic by suggesting that gender as a social construct is not always perceived as a binary depiction of femininity or masculinity, and categorizing gender into only two separate categories excludes or pathologizes a portion of the population (Joel et al., 2014; Lips, 2020). Going beyond dualities, many people feel they fall

somewhere on a spectrum between the standard categories of masculine and feminine. Gender is a part of a continuum and can change over time (CIHR, 2023). The word "genderqueer" is sometimes used to describe people whose gender is not defined by the usual male-female binary categories but lies somewhere between them or is otherwise distinct from either (Joel et al., 2014; Lips, 2020). Thus, it may be time to demand "a new conceptualization of gender that acknowledges the multiplicity and fluidity of the experience of gender" (Joel et al., 2014, p. 291).

Despite the discussion on gender and sex, there is still an absence of research on health disparities across the gender spectrum, particularly for intersex, transgender, and nonbinary individuals. Further investigation is needed to better understand and address the healthcare needs of these populations. (Cirillo et al., 2020; Jones, 2018; Scandurra et al., 2019). For people who identify as sexually and gender non-conforming (lesbian, gay, bisexual, and transgender), the effects of AF are much less well understood and studied (Benjamin et al., 2023) despite investigators using the National Inpatient Sample reporting more than 2.9% of transgender patients undergoing gender-reassignment surgery had concomitant AF (Antwi-Amoabeng et al., 2020; Benjamin et al., 2023).

Sex and Gender Disparities in Healthcare.

Transitioning from the conceptual understanding of sex and gender, examining how these disparities appear in a healthcare setting is vital. An expandingly important area of research in the health sciences is exploring sex and gender differences in health and well-being inequalities (Rich-Edwards et al., 2018; Shansky, 2019). These differences are influenced by complex relationships between biological and socioeconomic factors (see Figure 1) as well as a wide range of personal, social, economic, and environmental factors (Canada, 2022). These

relationships "are often surrounded by confounding variables such as stigma, stereotypes, and the misrepresentation of data" (Cirillo et al., 2020, p. 2). As a result, sex and gender biases and inequities can be present in health research and practices (Cirillo et al., 2020; Hay et al., 2019; King-Shier et al., 2015).

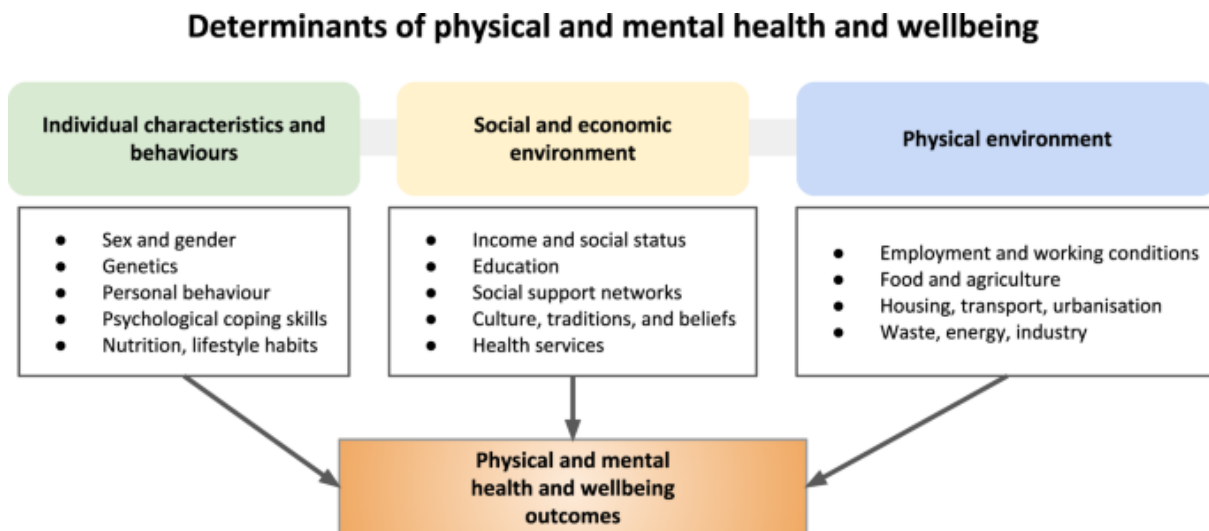


Figure 1: The Key Determinants of Health (Cirillo et al., 2020). Reproduced with no alterations under a Creative Commons License: <https://creativecommons.org/licenses/by/4.0/>.

Without enough awareness of sex and gender-based studies, it has been common practice to overlook patients due to a lack of understanding of sex and gender-based studies. Hølge-Hazelton and Malterud (2009) proposed that the "notion of gender neutrality is still alive in the medical culture, suggesting that gender issues are not relevant within this field (Hølge-Hazelton & Malterud, 2009, p. 139).

Despite laws requiring both men and women to participate in medical research, gender-blind attitudes still exist (Hølge-Hazelton & Malterud, 2009; Samulowitz et al., 2018). Gender blindness refers to the lack of awareness that medical knowledge is based on research conducted primarily by men, which hinders gender equity in healthcare (Lagro-Janssen, 2012). Gender blindness can lead to women's needs being overlooked, as seen in the case of coronary heart

disease (Johnston et al., 2013). Similarly, other biases have been well-documented in various medical conditions, with women often disproportionately affected (Björkman et al., 2014; Dekker et al., 2016; Sliwa et al., 2010). For example, studies have shown that women tend to receive less aggressive pain management compared to men, resulting in poorer pain control (Björkman et al., 2014). Some Pain management studies revealed that women with chronic pain had their symptoms being attributed to psychological factors rather than physical causes (Barker, 2011; Côté & Coutu, 2010; Hoffmann & Tarzian, 2001; Katz et al., 2008; Lillrank, 2003), with some women being referred to as "hysterical" (Barker, 2011; Katz et al., 2008).

As mentioned previously, the disparities in healthcare outcomes and treatment differences between men and women also extend to AF. Women with AF are less likely to receive therapeutic anticoagulation, an attempt to control their heartbeat, or undergo invasive cardiovascular procedures compared to men (Andrade et al., 2018, p. 429). However, gender neutrality also affects men, as demonstrated by the underdiagnosis of male depression, ascribed to a gap between perceived need and help-seeking behaviours (Möller-Leimkühler, 2002; Samulowitz et al., 2018). The suppression of emotional expressiveness that traditional masculinity fosters is said to make getting help more challenging and to affect how depressive symptoms are perceived (Möller-Leimkühler, 2002). These disparities in care and outcomes can have significant implications for patients' health and well-being.

These findings underscore the importance of addressing sex and gender biases in healthcare and medical research. Recognizing and addressing these biases is crucial to ensure that healthcare and employment policies and support are inclusive and that all individuals are provided equitable care, regardless of sex and gender.

This systematic review and meta-analysis will attempt to distinguish sex and gender as distinct constructs, as suggested by the Canadian Institutes of Healthcare Research. Here, sex will be understood using West and Zimmerman (1987) original conceptualization of sex as a biological classification that is regarded as an individual biology, while gender will be viewed as a social and cultural concept (Krieger, 2003; Unger, 1979). However, as highlighted prior, some researchers have argued that it may be impossible to separate or differentiate between sex and gender cleanly. While gender was coined to differentiate between biological and social processes, a clear distinction is not always possible, and in medical research, the term is often combined or used interchangeably (CIHR, 2023; Heise et al., 2019; Lips, 2020).

The Impact of Quality of Life

Building on the discussion on healthcare disparities in the previous section, it is important to explore the impact of sex and gender on quality of life (QoL) outcomes for patients with Atrial Fibrillation. This is because AF has a profound effect on patients' QoL, reducing patients' overall QoL due to the debilitating end-organ consequences such as stroke. This reduction in QoL can be likened to that seen in heart failure (Randolph et al., 2016; Schron & Jenkins, 2005).

As mentioned previously, there is a substantial negative impact on the quality of life of those suffering from AF (Thrall et al., 2007). There are two primary treatment strategies for atrial fibrillation- heart rate control or rhythm control, i.e., an attempt to maintain sinus rhythm. (Westerman & Wenger, 2019). Research has proposed that one of the most important reasons for rhythm control or rhythm treatment is for an improvement in a patient's quality of life, other than the prevention of stroke (Dorian & Angela Brijmohan, 2020; Randolph et al., 2016; Son et al., 2019). This is because no rhythm or rate control treatment has demonstrated the ability to extend

life or impact morbidity when tested in random controlled trials (Dorian & Angela Brijmohan, 2020). This limitation in treatment highlights the need to consider QoL's outcomes.

It has not been easy to define quality of life, and numerous measures and methods exist. Some definitions of quality of life are: "the degree to which an individual is healthy, comfortable, and able to participate in or enjoy life events" (Jenkinson, 2024) or "an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns" (Rejeski & Mihalko, 2001).

Despite numerous definitions, the body of research consistently indicates a direct relationship between an individual's overall health and quality of life (Karimi & Brazier, 2016). For patients with a chronic illness like AF, QoL assessments become even more critical because the disease and its treatment can impact various aspects of QoL (Kasar & Ozer, 2023; Leung, 2019).

Furthermore, QoL is closely tied to and often used interchangeably with Health-Related Quality of Life (HRQoL) (Karimi & Brazier, 2016), which can be defined as "how well a person functions in their life and (their) perceived well-being in physical, mental, and social domains of health" (Stenman et al., 2010, p. 196). As highlighted in Figure 1, you may recall that individual characteristics (i.e. sex and gender) and social, economic and physical environment (i.e. income, social support and employment) all impact well-being outcomes, making HRQoL an area to examine. For example, Altiok et al. (2015) found that people with permanent AF may steer clear of strenuous tasks like housekeeping, exercise, climbing stairs and working out of concern that it will cause them to experience palpitations.

Because of these restrictions brought on by AF symptoms, the person may distance themselves from social interactions, lowering life satisfaction (Altiok et al., 2015). Since we

have established that a person's circumstances and life conditions, such as employment outcomes, shape QOL and HRQoL or well-being, this study will focus on how individual characteristics, particularly sex and gender, interact with social, economic and physical outcomes, with an emphasis on employment outcomes. This article will focus on the employment-related reported QOL outcomes. By exploring these interactions, we can better understand the complex ways AF impacts well-being.

Atrial Fibrillation and Employment

Building on the exploration of Quality of Life (QoL) impacts for patients with Atrial Fibrillation (AF) due to its symptoms, it is vital to examine the broader implications of this condition on employment and work. Employment typically involves a contractual relationship between a worker and an employer, providing financial and other forms of remuneration. Work encompasses not only paid employment but also unpaid activities, education, and domestic responsibilities (Waddell, 2006, p. 4). Considering that 5 million people are diagnosed with AF every year and that AF and other Cardiovascular disorders (CVD) are becoming increasingly more common among the working-age (Chugh et al., 2014), the impacts of AF on the working populace and employment outcomes such as employment and unemployment, work accommodations and support from employers, and return to work need to be considered.

Research has also demonstrated a strong correlation between employment and overall health and well-being, with evidence indicating that employment can benefit physical and mental health and well-being overall (Ross & Mirowsky, 1995; Van Der Noordt et al., 2014; Waddell, 2006) Conversely, job loss and unemployment can have detrimental effects on health, exacerbating the challenges faced by those with chronic conditions like AF (Litchfield et al.,

2016; Waddell, 2006). Thus, it is vital to examine the central research question of: *How sex and gender impact employment outcomes in adult patients with atrial fibrillation?*

Return to work.

Work is important to study as it not only supplies monetary benefits but also a sense of purpose and structure. Return to work is a complex process, especially following a diagnosis.

To begin with, research has demonstrated that several factors, including the medical severity of the disorder, work-related factors and support, personal factors, and compensation policies, can predict a patient group's likelihood of returning to work (Bakker, 2022; Cancelliere et al., 2016; de Vries et al., 2022; Hegewald et al., 2019). Successful reintegration into the workforce is an essential rehabilitative goal, as it affects patient recovery (Sidsel Marie Bernt Jørgensen et al., 2023) and also serves as a "major indicator of real-world functioning" (Cancelliere et al., 2016, p. 2). Unfortunately, individuals with AF often face difficulty returning to work (Gragnano et al., 2018), feel pressure to return to work (Bernt Jørgensen et al., 2022), and may experience difficulties in maintaining employment (Sidsel Marie Bernt Jørgensen et al., 2023; Bernt Jørgensen et al., 2022; Gragnano et al., 2018).

While there is a desire to return to work, premature integration back to work- also known as presenteeism- may negatively impact health. This is because work-related stress is linked to metabolic syndrome, which is a cluster of conditions that elevate the risk of heart disease, stroke and type 2 diabetes.(Chandola et al., 2006). For instance, a Prospective Cohort Study of 10, 308 employed participants found that workers exposed to chronic work stress had more than double the likelihood of developing metabolic syndrome than those without work stress (Chandola et al., 2006). Work-related stress or job strain has been hypothesized to contribute to the development of AF over time. Research indicates that job-related stress, defined as job strain, was linked to a

nearly 50% higher risk of incident atrial fibrillation in Sweden's working population (Fransson et al., 2018; Torén et al., 2015). Interestingly, when stratifying the analyses by sex, the association between job strain and atrial fibrillation was predominantly observed in men (Fransson et al., 2018; Fransson et al., 2015).

Moreover, gender disparities also exist in the pressures to return to work. With women historically bearing the household care responsibilities, a combined survey- and register-based study found that women reported higher pressure to return to work and inadequate social support when living with a partner or spouse, regardless of their occupational status (Bjarnason-Wehrens et al., 2007). Delays in returning to work following a cardiovascular illness have been shown to have severe long-term financial effects on individuals and their families, particularly in cases where social or employer systems are inadequate to offer sufficient financial assistance (Hegewald et al., 2019).

The financial ramifications and other return-to-work difficulties highlight the need for employers to address barriers and support intervention strategies related to facilitating the return-to-work process. Authors have highlighted the lack of research on work-directed interventions (Bethge, 2016; Hegewald et al., 2019). The interventions could include workplace design changes and break policies (Hegewald et al., 2019), counselling or work-directed reintegration strategies. The Stepwise Occupational Reintegration (SOR) tool is an example of a work-directed reintegration strategy. SOR is a well-established tool in Germany designed to assist insured employees who are presently on sick leave in gradually returning to their jobs after a long-term illness (Bethge, 2016; Hegewald et al., 2019).

The Consequences of Unemployment.

In addition to the challenges of returning to work, unemployment also poses a risk to cardiovascular health. For example, a national longitudinal study of 8,812 participants in the US found that unemployment was associated with more than double the odds of AF (Soliman et al., 2017). This is supported by earlier research, which reports that cardiovascular health suffers substantial long-term effects from the psychological stress associated with unplanned job loss and unemployment (Weber & Lehnert, 1997). Additionally, rising unemployment impacts a population's overall happiness, as Di Tella et al. (2001) suggested in their paper reporting on the well-being statistics of a quarter of a million people from 12 European countries and the US. During financial hardship and times of uncertainty, unemployment goes beyond paid work and may also impact unpaid household labour and domestic work. Financial constraints increase unpaid household labour and could increase stress, as the lower income from before unemployment may deter people from outsourcing their household duties (Gimenez-Nadal & Molina, 2014). This reallocation of household labour is linked to lower levels of enjoyment and can negatively impact well-being (Kahneman & Krueger, 2006; Krueger, 2007) and thus QoL discussed in the previous sections.

Gender Roles and Unpaid Labour.

Building on the reallocation of household labour in the prior section, unpaid labour (also referred to as unpaid work, unpaid care work, domestic labour or work, or household labour throughout this study and other literature), is generally understood as duties and tasks performed to support a household and its members without any explicit monetary compensation. This could include household activities like cleaning and laundry but also childcare or eldercare activities. Previous research on how life events (such as being diagnosed with AF) can affect gender roles

and the gendered distribution of labour between men and women has demonstrated that gender roles can change and adapt to accommodate (either freely or involuntarily) circumstances (Bolzendahl & Myers, 2004). For example, a study using a representative sample of respondents in the U.S., Germany, and Singapore to investigate the effects of the COVID-19 pandemic on men and women discovered that women are more negatively impacted than men in the labour market because they are more likely to work from home, cut back on hours, and become unemployed (Reichelt et al., 2021). However, some studies indicate that men increased their domestic and childcare activities and housework during the lockdown (Bujard et al., 2020), although mothers still took on more of the housework than their main counterparts (Bujard et al., 2020; Pailhé & Solaz, 2008).

A theoretical framework to explain this additional housework is the ‘doing gender’ perspective proposed by West and Zimmerman (1987). West and Zimmerman (1987) maintain that “‘doing gender’ is a complicated process of interactional, perceptual, and micropolitical actions governed by societal norms that interpret certain activities as manifestations of masculine and feminine natures” (West & Zimmerman, 1987, p. 126). This framework suggests that in changing circumstances such as an illness or unemployment, men show their masculinity by refraining from doing tasks that are traditionally associated with “women's work,” while women display their femininity by increasing their homecare or homecare activities (Van der Lippe et al., 2018; West & Zimmerman, 1987). Feminist theorists contend that societal norms for domestic labour allocation have an economic impact on women's engagement in the labour market (Fraser, 2000; Lyonette & Crompton, 2015; West & Zimmerman, 1987).

Despite the rise in women's "breadwinning" capabilities and earnings, traditional expectations for domestic labour persist (Lyonette & Crompton, 2015). Some evidence suggests

that women who earn more than their male partners are sometimes observed to perform more housework (Atkinson & Boles, 1984; Lyonette & Crompton, 2015), while others maintain that men do increase their domestic contribution as their female partners' income rises (Gupta, 2007, p. 402; Gupta & Ash, 2008; Harkness, 2008). This is consistent with the exchange-bargaining theory, which proposes that women reduce household chores as their income rises, up to the point where both spouses contribute equally to income (Bittman et al., 2003). However Risman (2011) suggests, "this does not mean that men are equally sharing household labour... rather, it may mean that more privileged women are more often hiring poorer ones to do the devalued feminized household labour" (Risman, 2011, pp. 18-19). Nonetheless, the pressures of full-time employment are incompatible with domestic responsibilities for all and may impact patients with AF (Lyonette & Crompton, 2015)

While the 'doing gender' thesis has traditionally explained how these roles are maintained, according to scholars like Deutsch (2007), the attention should be shifted to how we may "undo" gender and argued that West and Zimmerman's theory reinforced the inevitable nature of inequality (see also (Butler, 2004; Lyonette & Crompton, 2015)). To simplify, doing gender is understood as enacting gender differences, while undoing gender is reducing gender differences (Deutsch, 2007). This aligns with Butler (2004) concept of gender performativity which contends that because gender is done, it can also be undone and explains that it is possible "to undo restrictively normative conceptions of sexual and gendered life" (Butler, 2004, p. 1). An example of doing gender would mean that the gender hierarchy is enacted by favouring the masculine over the feminine; however, if gender were to be undone, that would mean gender differences and inequalities are lessened by not preferencing either the masculine or the feminine (Kelan, 2018, p. 8). In the context of AF and employment, undoing gender could mean that

traditional gender roles and the norms around caregiving, household responsibilities, and employment can be reimagined and challenged (Risman, 2009; Seregina, 2020).

Conclusion: The Intersection of Atrial Fibrillation, Sex and Gender and Employment

This research has synthesized the intricate intersections of employment, sex, and gender in patients with atrial Fibrillation (AF). It has highlighted the significant challenges these individuals face in returning to work, the role of job strain, sex and gender on cardiovascular health. The discussion also underscored how traditional gender roles and domestic labour expectations shape employment outcomes, particularly for women, affecting their ability to compete equally in the labour market.

The analysis has summarized that successful reintegration into the workforce is influenced by numerous factors, including the severity of the condition, workplace support, and existing compensation policies (Cancelliere et al., 2016; Hegewald et al., 2019; De Vries, 2018; Den Bakker, 2018). It has also shed light on the gender disparities in the pressure to return to work and the financial implications of delayed reintegration (Bjarnason-Wehrens et al., 2007; Hegewald et al., 2019).

Furthermore, this research explored the enduring gender roles in domestic labour (Bolzendahl & Myers, 2004; Reichelt et al., 2021; Bujard et al., 2020; Pailhe & Solaz, 2008; Andrew et al., 2022). These roles continue influencing women's employment outcomes, underscoring the need for supportive workplace policies and interventions considering these gendered dynamics (West & Zimmerman, 1987; Fraser, 2000; Lyonette & Crompton, 2015).

This systematic review and meta-analysis will investigate the intersection of individual characteristics, such as sex and gender, and how that shapes employment participation, such as return to work, unemployment, and unpaid labour.

This main research will examine:

- *How does sex and gender impact employment outcomes in adult patients with atrial fibrillation?*

The secondary research question(s) will be:

- *To what extent is gender analysis included in current research on employment outcomes for individuals diagnosed with atrial fibrillation?*
- *What types of employment outcomes are reported for individuals diagnosed with atrial fibrillation?*

The next section details the methods used to address these research questions.

Methods

Search Strategy

A systematic review of studies was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA 2020) guidelines to ensure a rigorous and transparent approach. As mentioned previously, a systematic review and meta-analysis were chosen as they help synthesize the state of knowledge (Page et al., 2021) in the field of atrial Fibrillation (AF), addressing questions individual studies cannot answer and generating or evaluating theories about the impact of sex and gender on employment outcomes in AF patients. This study aims to speak to multiple audiences, including patients, healthcare providers, researchers, and policymakers, and ultimately guide future research and Policy interventions.

Furthermore, PRISMA guidelines are internationally recognized and provide a standardized method for conducting systematic reviews and meta-analyses. PRISMA guidelines were chosen to ensure that the results produced through this review are reliable, credible, and reproducible by reducing bias.

An experienced research librarian was consulted to facilitate the design of an effective search strategy. Collaboration with the librarian helped refine the search terms and databases to ensure coverage of relevant literature. I searched the following databases: PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Cochrane Library, and Web of Science. The search used a combination of keywords in the title and abstract, as well as Medical Subject headings (MeSH) terms, including "atrial fibrillation," "afib," "AF," "employment," "unemployment," "career," "labour," "work", "gender," "gender identity," and "sex." The search strategies used for each database are available in [Appendix C](#). Databases were supplemented by a manual screening of the identified studies' bibliographies (hand search) and a Google Scholar targeted search for comprehensiveness.

The scope of the literature search followed the population, exposure, and outcome (PEO) format. The population (P) of interest comprises adults over 18 years affected by atrial Fibrillation (AF). The exposure (E) is sex and/or gender, and the outcomes (O) include any available employment outcomes by sex and/or gender. The PEO format allowed for a more precise and targeted search and increased the likelihood of capturing all relevant studies.

Study Selection

The exclusion criteria involved editorials, case studies, ongoing studies, papers in languages other than English, and studies involving animals, cells, non-AF conditions, and minors. Instead, the two investigators (M.O. and T.R.) consider studies that investigated the

effects of AF on sex and gender as well as any employment outcomes such as employment or unemployment, work accommodations and support (such as disability pay and insurance) and return to work impacts for patients with AF. All studies were restricted to the English language, including those of human subjects who are at least 18 years old. There were no date restrictions on the publication period. Studies were included in the meta-analysis if they include sex and/or gender-stratified data and/or analysis on at least one of the outcomes of interest.

Data Extraction

Two investigators (M.O. and T.R.) separately evaluate article titles and abstracts to exclude papers that are not relevant according to the inclusion and exclusion criteria. A full-text review was then be conducted to identify papers for inclusion. At each step, disagreements were addressed by consensus or, if needed, by consulting a third reviewer (M.R.). The aim of this independent assessment was to reduce the risk of selection bias and enhance the reliability of the review process in accordance with systematic review recommendations (Lasserson et al., 2023).

For the included studies, data extracted included the study title, first author, study objective, country, year of publication, characteristics of population, sex, gender (if available), number in employment, and any other employment outcome(s).

Assessment of Risk of Bias in Included Studies

An assessment was done to assess the risk of bias using ‘the Newcastle-Ottawa Scale (NOS) as suggested by Cochrane for observational, non-randomized studies such as cohort studies, case-control studies and cross-sectional studies (adapted), which all the extracted articles mostly consisted of (Egger et al., 2022; Patra et al., 2015). Domains and the assessment for each article can be found in [Appendix D](#) . In the assessment, each study can be awarded up to nine points for the risk of bias in three areas: in the study group selection (four points); the group

comparability (two points); and lastly, the exposure and outcome determination (three points) (Lo et al., 2014). NOS study quality was then graded according to the total score in accordance with the NOS recommendations for converting the NOS scales to AHRQ standards of good quality, fair quality and poor quality (Wells et al., 2014).

Data Synthesis and Statistical Analysis

Continuous variables were described as the mean and standard deviation. Data was expressed as Odds Ratios (ORs) with 95% confidence intervals. All effect sizes were presented with their 95% confidence intervals.

A Fixed effect meta-analysis was performed using R software, R version 4.4.2, as the studies included in the meta-analysis have similar measures and sample characteristics. Effect sizes for each study were displayed along with the pooled meta-results. Data was pooled from eligible studies for the primary outcome measure discovered: employment and unemployment in relation to AF, sex, and the association between long working hours and AF. Data on return to work, gender, work accommodations and support (such as disability pay and insurance) data and unpaid labour were not pooled because of the lack available data in the reporting of these outcome measures but were discussed in the results section.

Inconsistency in the network was quantified using Cochran's Q and the I^2 statistic. This I^2 statistic provides an estimate of the percentage of variability in results across studies that is due to real differences and not due to chance or sampling error (Thorlund et al., 2012). Both within-study and between-study tests of heterogeneity were performed. A p-value <0.05 for the Q test was considered statistically significant. An I^2 value of 30% or less represents a low level of heterogeneity, 30%-60% represents a moderate level of heterogeneity, and values over 60% signify substantial heterogeneity (Lasserson et al., 2023). So, If the I^2 statistic is high, it indicates

that the study results vary significantly, and the differences are likely due to actual differences rather than just chance (Lasserson et al., 2023).

Why was it Important to do a Systematic Review?

A systematic review collects all possible research on a topic and then assesses and analyzes its results (Ahn & Kang, 2018). By systematically evaluating this primary research, systematic reviews seek to present a current summary of the state of knowledge (Lasserson et al., 2023) and will help synthesize the state of knowledge in the field of atrial Fibrillation (AF) and sex, gender and employment. Following the systematic review, an assessment of the quality of the study was performed, and a statistical meta-analysis of the qualifying quantitative studies was conducted (Ahn & Kang, 2018).

Systematic Reviews also offer numerous advantages relevant to audiences inside and outside the research community, such as policymakers, healthcare providers, employers, and patients. Firstly, they allow for a more transparent evaluation of the findings from traditional reviews and could clarify and resolve uncertainty when individual studies disagree (Egger et al., 2022); a systematic review reduces the risk of being misled by research evidence, compared to relying on individual studies (Lavis et al., 2005). Secondly, systematic reviews save time for other researchers and policymakers as the research is sorted systematically and appraised for quality (Lavis et al., 2005). Thirdly, the methodological rigour of systematic reviews encourages researchers to examine the material on research design, analytical methods and causal chains (Mohamed Shaffril et al., 2021).

With the high control for quality and the comprehensiveness of evidence built into systematic review methodology (Lockwood et al., 2015; Mallett et al., 2012), policymakers can better translate knowledge synthesis from systematic reviews into policy and the adoption of

policies. Policymakers often report barriers to using research, such as the ease of access to high-quality, relevant research and the timeliness and relevance of the research which systematic reviews offer (Lavis et al., 2005; Moore et al., 2011; Oliver et al., 2014). So, this synthesis may be necessary to ensure policy decisions are based on high-quality data for more effective policy interventions.

A meta-analysis, which is often part of systematic reviews, also offers numerous additional advantages, including standardized methods to reduce bias (X. M. Wang et al., 2021). By combining data from multiple studies, meta-analysis can help address the limitations associated with smaller sample sizes and provide a comprehensive analysis of the data across studies as well as answering questions that individual studies may not be able to answer (Ahn & Kang, 2018). However, systematic reviews and meta- also have limitations such as publication bias, which is an "editorial predilection for publishing particular findings, e.g., positive results, which leads to the failure of authors to submit negative findings for publication (Thornton & Lee, 2000, p. 208) and the potential for missing related research in the search process (X. M. Wang et al., 2021). They also carry the risk of being misleading. They can lead to inaccurate results being derived from the review and analysis, especially if specific study designs, within-study biases, variation among studies, and reporting biases are not adequately considered (Ahn & Kang, 2018; Lasserson et al., 2023). A comprehensive search strategy from different databases and including all relevant studies identified in the methods section of this proposal will aid in addressing the limitations associated.

To distinguish between the two, a systematic review provides a synthesis of the existing literature, while a meta-analysis is a statistical analysis within the systematic review. Not all systematic reviews include a meta-analysis (Haidich, 2010). A systematic review endeavours to

assemble empirical data that fits predetermined eligibility standards to address a particular inquiry (Haidich, 2010). In contrast, a meta-analysis is “the statistical analysis of a large collection of analysis results from individual studies to integrate the findings” (Glass, 1976, pp. 3-8).

While, as previously mentioned, systematic reviews are beneficial to a wide range of stakeholders, such as policymakers, employers, and patients, meta-analyses are particularly valuable for clinical researchers and practitioners, helping to evaluate the strength of evidence regarding treatments, tests, or diseases (Haidich, 2010; Patsopoulos et al., 2005). By pooling data, meta-analyses offer more statistical power and can improve the precision of effect estimates. However, if the included studies are not sufficiently similar, the results of a meta-analysis can be misleading (Lasserson et al., 2023). Therefore, a meta-analysis is not always appropriate and not all systematic reviews use them (Lasserson et al., 2023).

Despite the documented advantages of systematic reviews for various audiences, many healthcare systematic reviews focus on randomized controlled trials (Egger et al., 2022) and clinical outcomes, with clinicians as the target audience (Lavis et al., 2005). This focus may neglect the non-clinical quality of life outcomes such as employment (Karimi & Brazier, 2016, p. 5). This systematic review and meta-analysis aim to address this gap by examining how sex and gender influence employment-related outcomes for individuals affected by AF, guided by PRISMA 2020. Ultimately, the results in the next section are intended to offer meaningful insights to policymakers, researchers, and healthcare professionals, directing future research and policy initiatives.

Results

Results of the Search

The systematic review identified a total of 634 references. After removing duplicates manually and through Covidence, twenty studies met the inclusion criteria for qualitative synthesis, and eight were included in the quantitative synthesis of data for meta-analysis. [Figure 2](#) depicts the PRISMA flowchart, a visual representation of the screening process, to help understand the process and rationale behind the inclusion and exclusion of studies. Most excluded studies (n=136) did not have any type of employment outcome.

The most frequently reported outcome across the included studies was the association between AF and employment status; however, acknowledging the different definitions of employment across the included studies is important. For instance, while Gurusamy et al. (2019) and Potpara et al. (2013) classified retirees as "unemployed," Lunde et al. (2022) excluded retirees due to their focus on work disability benefits. Some studies combined paid labour with household labour, whereas others strictly measured paid employment. To recognize the global experiences and contexts for people with AF, this review did not place any restrictions on the employment definitions used.

Characteristics of Included Studies

Of the included studies, geographically, the most represented country was the United States of America (n = 5; 25%), followed by Denmark (n = 3; 15%). Canada (n=2; 10%), Sweden (n=2; 10%), and the United Kingdom (n=2; 10%) each had two studies. Additionally, a single study originated from Norway (n=1; 5%), Poland (n=1; 5%), Serbia (n=1; 5%) and a joint study (n=1; 5%) was conducted across the United Kingdom, Denmark, Sweden, and Finland.

The studies were published between 2000 and 2023, and Figure 4 depicts the average years of publication of the included studies.

Methodologically, the literature primarily consisted of cohort studies (n = 12; 70%), cross-sectional (n = 6; 30%), and case-control (n = 1; 5%); survey research (n = 1; 5%) represented less (Figure 5). The remaining data extraction and findings results are summarized in [Table 1](#), and [Appendix A](#) contains more detailed characteristics of each study extracted through Covidence.

The included studies varied in quality, using the Newcastle-Ottawa Scale (NOS) adapted for the different study designs. The twelve cohort studies achieved "Good" ratings because of their appropriate control of confounding variables and adequate follow-up periods. These studies also frequently used extensive population-based data, contributing to their higher-quality assessments (Table 6). The quality of the six cross-sectional studies varied from "Good" to "Fair." Studies that scored well generally had sampling representative of the average in the AF population, appropriate tools for measuring risk factors, and proper statistical analysis. Those rated as Fair often lacked a description of clear sampling strategies, had limited information about non-responders, or relied heavily on self-reported data (Table 7). The single case-control study received a "Poor" rating due to unclear control group selection and limited information about non-responders (Table 8). Detailed results of each quality assessment can be found in [Appendix D: Quality Assessments](#).

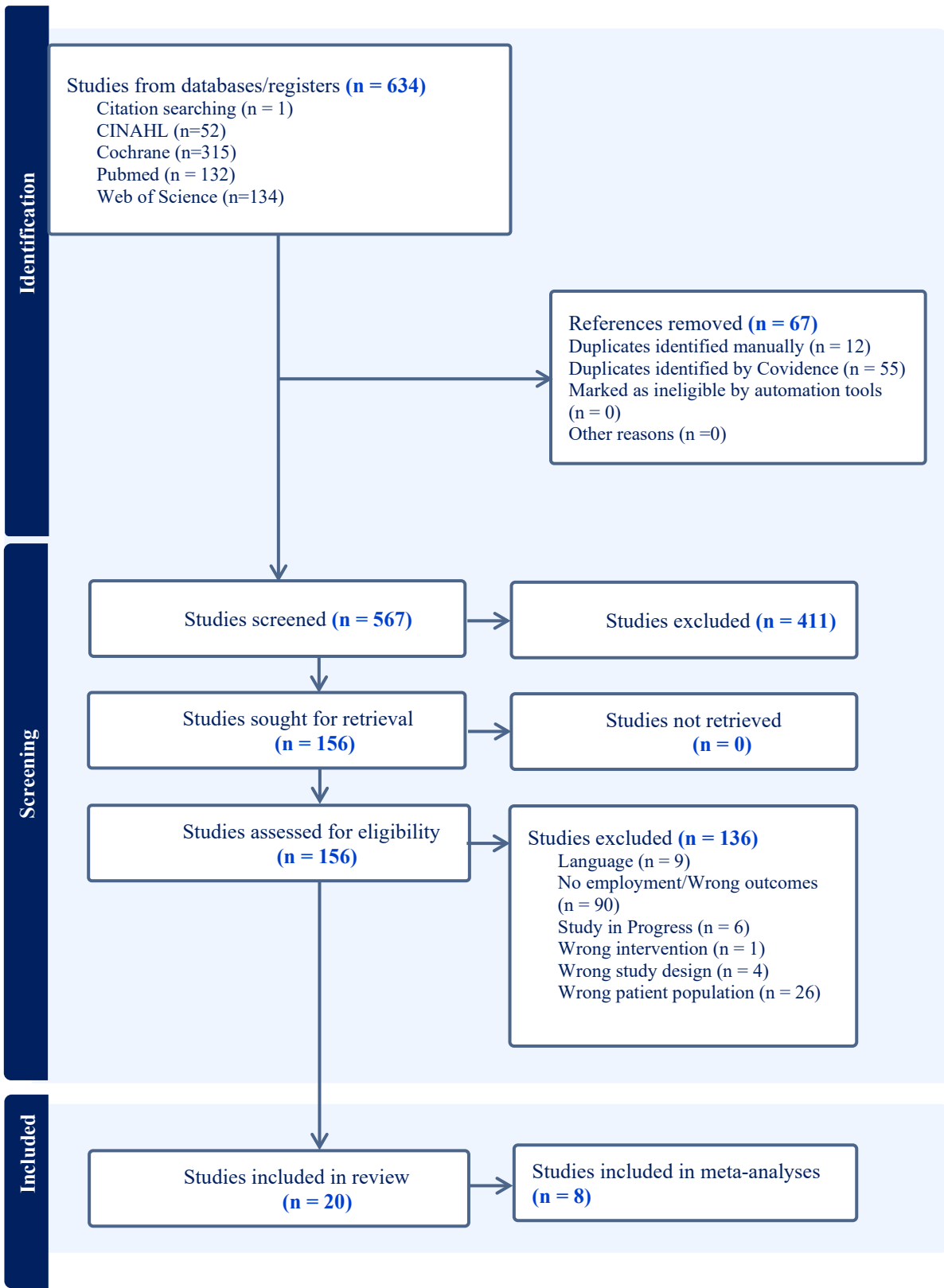


Figure 2: PRISMA Flowchart

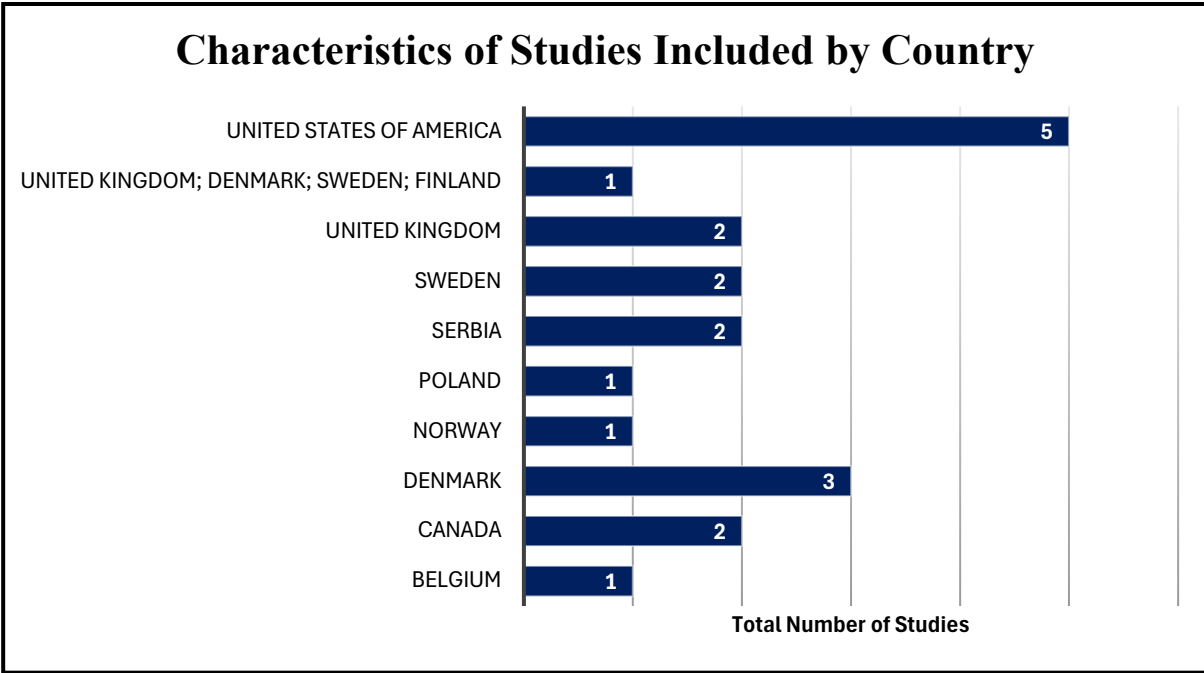


Figure 3: Characteristics of Studies by Country

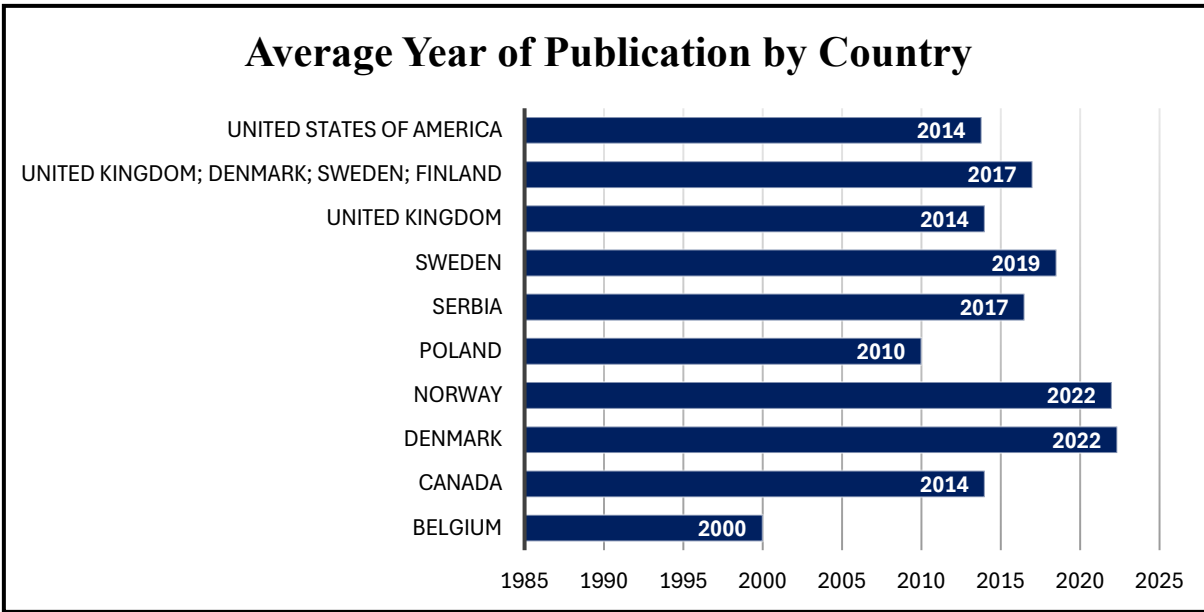


Figure 4: Average Year of Publication by Country

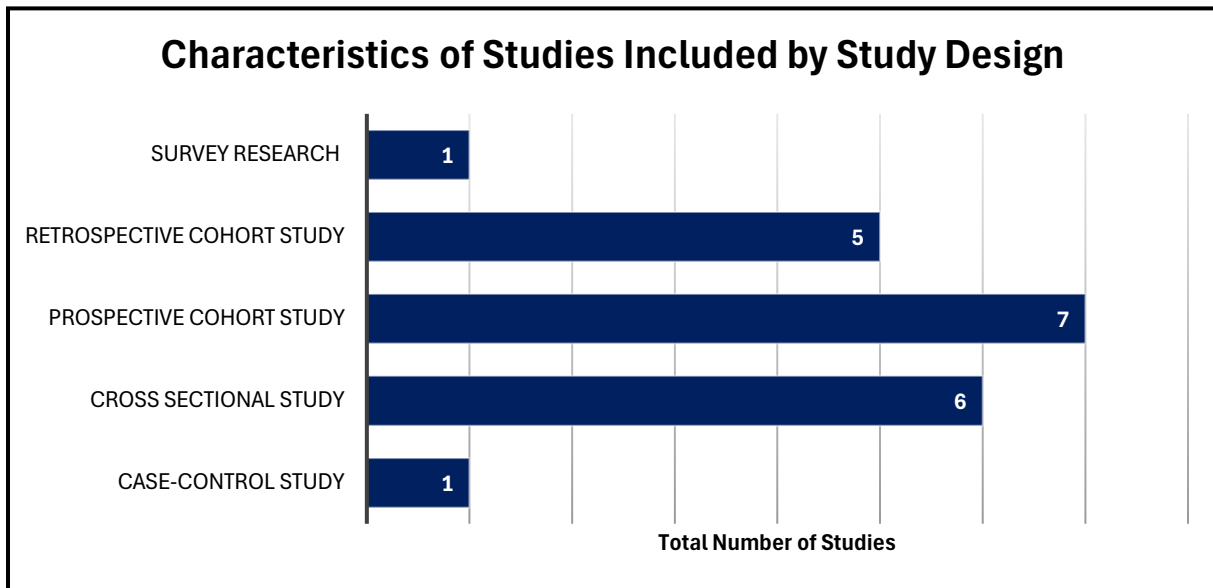


Figure 5: Characteristics of Studies Included by Study Design

Results of the Systematic Review.

Barriers to Return-to-Work and Work Retention

A common theme emerging from the qualitative analysis is the barriers to employment retention and return-to-work (RTW) for individuals with atrial fibrillation (AF). First, S. M. Bernt Jørgensen et al. (2023) found that 20% of Danish AF patients experience detachment from employment post-diagnosis, with low-income workers disproportionately affected due to limited sick leave benefits and physically demanding roles. Detachment from work, in this case, was described by the authors as not being self-supporting or receiving public benefits (including disability pensions, unemployment benefits, and sick leave).

This economic expense was quantified by Wu et al. (2005) who estimated that AF-related work loss due to absenteeism costs \$14,875 annually per patient. Notably, sex and gender disparities further compounded these challenges with women aged ≤ 55 with AF reporting a

51.7% (95% CI: 32.5 – 70.6) probability of perceived RTW pressure, compared to 30.2% (95% CI: 21.3-40.4) for men. Financial insecurity (10.1%) and employer expectations (7.0%) drove some of this pressure (Bernt Jørgensen et al., 2022).

Work-Related Quality of Life Impairments

For work-related impairments and impacts on QOL, Dąbrowski et al. (2010) found that 40.2% of men and 18% of women with AF reported limitations in paid employment. Bohnen et al. (2011) provided further insight through a spouse comparison study. While 70.2% of AF patients perceived their work impairment as "mild" compared to 79.8% of spouses, 10.8% (37) of AF patients and 6.1% (seven) of spouses were affected severely ($P = 0.041$).

Lastly, Potpara et al. (2013) reported similar findings and highlighted the emotional and financial toll of AF, with 68.4% of patients reporting that AF negatively influenced their careers.

Unpaid Labour and Lack of Gender Analysis

In addition to the impacts on paid work, AF also impacts domestic labour and household activities. Qualitative insights from Dąbrowski et al. (2010) revealed that patients with paroxysmal and permanent AF described their arrhythmia as most limiting regarding work, and household activities. While no other study directly measured unpaid labour, Dąbrowski et al. (2010) noted that 46% of women with AF reported limitations in household activities compared to 26% of men ($p < 0.05$).

Most of the articles were limited to a sex-based analysis. When gender was used, it was often used interchangeably with sex. Only a few articles (such as (Dąbrowski et al., 2010; Ong et al., 2006; Sultan-Taïeb et al., 2022; Thrall et al., 2007) explicitly referenced to gender.

Table 1: Studies included in the Systematic Review and Meta-analysis

Author Year	Main Outcome	Intervention/Comparator	Country	Design	Total Sample Size n	Findings
BerntJørgensen 2022	Return to work (RTW) and employment after AF diagnosis	AF vs no-AF	Denmark	Retrospective cohort study	Overall: n= 8187 With AF: n= 2568 (31.4%) Other CVD (heart failure (HF), heart valve disease, and ischaemic heart disease): n=5601	The probability of detachment from employment (not being self-supporting and sick leave benefit, unemployment benefit or another benefit, and pension (including disability pension) was found among 20% of individuals diagnosed with AF after returning to work (20.0%, 95% CI: 18.3–21.5) lower income unfavoured return to work and employment maintenance and workers with a lower socioeconomic position might experience additional barriers for returning to work.
BerntJørgensen 2023	Probability of feeling pressure to return to work	AF vs no-AF, male sex vs female sex	Denmark	Retrospective cohort study	842 (with AF=370) -9329 eligible participants	The most commonly cited source of pressure to return to work was the job counselling centre (13.9% of 838 respondents). In Denmark, all Danish citizens are entitled to paid sick leave, and job counselling centres are responsible for the administration of sickness absence. Approximately one-tenth of respondents had felt financial pressure (10.1%) or had cited ‘other reasons’ (10.8%) for feeling pressure to return to work. Some respondents had felt pressured to return to work by their employer (7.0%), their relatives (0.6%) or their colleagues (data not shown). Individuals who have a lower socioeconomic status may be under more pressure to return to work than those who have a higher socioeconomic status because the former are more likely to be underinsured and have less favourable sick leave arrangements and short-term disability benefits. Among women aged ≤55 years with AF the observed probability of perceived return-to-

Author Year	Main Outcome	Intervention/Comparator	Country	Design	Total Sample Size n	Findings
						work pressure was 51.7% (95% CI: 32.5–70.6), the probability of pressure was 26.1% (95% CI: 14.3–41.1) for women aged > 55 years with AF. For men, aged ≤55 years with AF the observed probability of perceived return-to-work pressure was 30.2% (95% CI: 21.3–40.4), and 18.3% (95% CI: 13.1–24.6) among respondents aged > 55 years.
Bohnen 2011	Effects of AF on work life	AF vs no-AF (Spouse group)	United States of America	Survey Research	Overall: n= 527 With AF: n= 411 No AF (Spouse group) n=129	AF patients experienced a greater effect on work life than spouses in the subgroup analysis. The authors noted that more than two-thirds of the respondents (AF patients 70.2% [240] vs. Spouses 79.8% [91]) perceived the effect as mild. 10.8% (37) of AF patients and 6.1% (seven) of spouses were affected severely (P = 0.041) QoL Measurement: QoL was assessed on the basis of four components: physical condition, psychological well-being, social activities, and everyday activity
Dąbrowski 2010	Effects of current health status on work (paid employment) and household activities (cleaning, cooking, small repair), QOL	male sex vs female sex	Poland	Case-control study	Overall: n= 220 With af: n= 150 With No Af (control group): n= 70	Analysis of the second part of the NHP questionnaire revealed that the arrhythmia in patients with paroxysmal and permanent AF was most limiting in regard to sex life, work, and household activities, and least limiting in regard to home life. In patients with persistent AF, limitations were mostly perceived in regard to household activities and free time, and least related to home life, interests and hobbies Different questions of BDI evaluate ...difficulties at work
DeBacquer 2000	Association between ECG findings and employment	ECG in Employed vs Unemployed, ECG in Male	Belgium	Cross sectional Study	47 358	Being currently employed was associated with a lower prevalence of minor and T wave abnormalities and consequently with a lower prevalence of ischaemic ECG findings.

Author Year	Main Outcome	Intervention/Comparator	Country	Design	Total Sample Size n	Findings
		sex vs female sex				
Fransson 2018	Job strain & risk of AF given job strain	male sex vs female sex	Sweden	Prospective cohort study	13200	The authors found that job strain was associated with an almost 50% increased risk of incident atrial fibrillation in the general working population in Sweden. When pooling the results from all three studies, job strain was associated with a 37% higher risk of atrial fibrillation.
Goren 2013	Employment status, HQOL (MCS, PCS), having health insurance	AF vs no-AF	United States of America	Cross sectional Study	Overall: n=2492 With af: n= 1296 With No Af: n=1296	Activity impairment was significantly higher for AF patient's vs the non-AF controls group; Mental and Physical Component Summary (MCS and PCS) scores were lower for AF group. Health-related quality of life measurement (HRQoL) was assessed using the physical (PCS) and mental (MCS) component summary scores from the SF-12v2, and health utilities (calculated from seven SF-12v2 items)
Gurusamy 2019	Association between AF treatment (non-vitamin K antagonist oral anticoagulants (NOACS) vs s. Warfarin and employment status.	Treatment (NOAC vs Warfarin)	Sweden	Cross-sectional Study	68,056	Higher education, higher income and professional occupations were all associated with an increased likelihood of starting preventative anticoagulant therapy with a NOAC, consistent with previous research on newly marketed drugs. In the multivariable analysis, after adjusting for potential confounders, including comorbidities and comedications, patients in rural areas of Sweden were half as likely to be started on a NOAC than patients in urban regions of Sweden, OR 0.48 (95% CI: 0.45–0.51). Having university or college level education (post-secondary) was associated with a 37% higher likelihood of starting treatment with a

Author Year	Main Outcome	Intervention/Comparator	Country	Design	Total Sample Size n	Findings
						NOAC compared with having compulsory level education (≤ 9 years). A higher likelihood of receiving a NOAC as an initial anticoagulant was also seen for patients employed in higher clerk/leading positions (OR 1.41 95% CI: 1.27–1.58), qualified white-collar workers (OR 1.20, 95% CI: 1.09–1.32) and for foreman/ technician jobs (OR 1.74, 95% CI: 1.10–2.75), when compared with retired/unemployed patients.
Kivimäki 2017	Association between AF attributed to long work hours (10-year cumulative incidence)	shift work vs standard working hours, Incident AF vs no AF	United Kingdom; Denmark; Sweden; Finland	Prospective cohort study	Overall: n= 85494 With Incident AF: n=1061 Without Incident AF: n=84433	In age, sex and SES-adjusted analyses, participants working long hours were at increased risk of incident atrial fibrillation: the hazard ratio compared with those working standard hours is 1.42 (95%CI 1.13–1.80, P = 0.0031). There was little heterogeneity in the cohort-specific estimates: I ² = 0%, P = 0.66. The association between long working hours and atrial fibrillation remained after adjustment for pre-existing coronary heart disease at the time of atrial fibrillation diagnosis (1.41, 95% CI 1.12–1.78, P = 0.0039) and excluding Baseline characteristic participants with cardiovascular disease at baseline (N = 549, hazard ratio 1.41, 95% CI 1.11–1.79, P = 0.0054) or cardiovascular disease at baseline or follow-up (N = 2006, hazard ratio = 1.36, 95% CI = 1.05–1.76, P = 0.0180).
Latif 2023	Association between employment and all 30-day readmissions following AF	male sex vs female sex	United States of America	Retrospective cohort study	16879	In the presence of a health-related social needs (HRSN) diagnosis, 30-day readmission rates were highest when the HRSN domain was due to housing, followed by psychosocial, socioeconomic, employment, and family

Author Year	Main Outcome	Intervention/Comparator	Country	Design	Total Sample Size n	Findings
Lunde 2022	Association between AF and the risk of work disability, permanent social security benefit	AF vs no-AF	Denmark	Retrospective cohort study	Overall: n= 340,726 With af: n= 28,059 With No Af (matched control group): n=312,667	<p>Patients with AF received more permanent social security benefits and had higher mortality rates than the matched reference cohort during both the 15-month and 3-year period.</p> <p>Overall, the risk of receiving permanent social security benefits was 4.5% (95% CI 4.3% to 4.8%) in the AF cohort, whereas it was 1.3% (95% CI 1.3% to 1.4%) in the matched reference cohort.</p> <p>Of individuals alive and still able to work 15 months after incidence AF, the AF cohort had a lower WPS (work participation score) than the matched reference cohort: WPS for the matched reference cohort was 90%, whereas it was 83% for the AF cohort and adjusted RD (risk difference) for the patients with AF was 5.9% (95% CI 6.3% to 5.5%). The same pattern with education, income and cohabiting status as seen for permanent work disability was seen for WPS.</p>
Ong 2006	Employment status, QOL (SF-36), marital/cohabiting	male sex vs female sex	Canada	Cross sectional Study	93	<p>No gender differences were found for age [t (58.02) =1.28, P=.64], education [$\chi^2(1)$ =1.00, P=.32], or employment status [$\chi^2(1)$ = 2.85, P=.09].</p> <p>(QOL method: Medical Outcomes Study Short-Form 36 Health Survey)</p>
Potpara 2013	Employment status, negative Impact on career, marital status/spouse, influence of treatment on career	Procedure vs no procedure	Serbia	Prospective cohort study	390 Employed 171 (43.8%) Retired 219 (56.2%)	<p>Patients were also asked whether AF negatively influenced their career (or working capacity) and/or private life; 267 patients (68.4%) answered, “Yes, my career”, and 273 patients (70.0%) thought that their private life was impaired (of note, 277 patients [71.0%] answered “Yes, both”). Only 81 patients (20.8%) stated that AF did not influence either their career or private life.</p>

Author Year	Main Outcome	Intervention/Comparator	Country	Design	Total Sample Size n	Findings
Potpara 2020	Employment status, QOL (5-item EQ-5D qol questionnaire), marital/cohabiting, Treatment burden (TB)	AF vs no-AF	Serbia	Prospective cohort study	Overall: n=514 with af= n=331 Without AF (Hypertension) n=183+M14	The mean self-reported TB was 27.6% among patients with AF and 24.3% among controls, P = 0.011. The mean EQ-5D QoL score value was numerically lower in AF patients (2.95 ± 3.25) than in non-AF controls (3.39 ± 3.35), P= 0.157 Younger age and female sex were multivariable predictors of a higher TB. QOL measurement: 5-item EQ-5D QoL questionnaire
Soliman 2017	Association of unemployment with atrial fibrillation by sex/health insurance/income etc., Perceived stress score (by employment vs unemployment)-scale- Cohen Perceived Stress 16-point Scale.	AF vs no AF, male sex vs female sex, employed vs unemployed	United States of America	Prospective Cohort Study	8812	association of unemployment with AF ODDS ratio Model 1: Age, sex, race, region of residence, education level: 2.44 (2.05, 2.90) Model 2: Income and health insurance status: 2.31 (1.88, 2.83) Model 3: Perceived stress measured by the Cohen Perceived Stress 16-point Scale. They excluded homemakers (n=1,406) the highest odds of AF were observed in those unable to work, then lost job for less than a year then lost job for more than a year. AF was detected in 673 (7.6%) participants
Sultan-Taïeb 2022	Burden of AF attributable to Long Working hors	male sex vs female sex	Canada	Cross-sectional Study	100,000 workers with outcomes (Coronary/ischemic heart diseases (CHD), stroke, atrial fibrillation, peripheral artery disease and depression)	The overall burden in Disability-Adjusted Life Years (DALY) for the psychosocial work factor (long working hours) was estimated at 1,697 DALYs for men and 254 for women in EU28 in 2015.
Thrall 2007	Employment status, QOL	AF vs no-AF (hypertension)	United Kingdom	Cross-sectional Study	Overall: n=198 with af= n=101 Without AF (Hypertension) n=97	Of the demographic variables gender $\beta = -0.13$) and employment status ($\beta = -0.20$) were related to QoL

Author Year	Main Outcome	Intervention/Comparator	Country	Design	Total Sample Size n	Findings
Wang 2021	Association btw AF & night shift work	shift work vs standard working hours, Incident AF vs no AF	United Kingdom	Prospective cohort study	Overall: n= 282457 With Incident AF: n=5777 Without Incident AF: n=276680	Shift work is a work schedule that falls outside of the normal daytime working hours of 9 a.m.–5 p.m. Usual or permanent night shifts were associated with the highest risk [hazard ratio (HR) 1.16, 95% confidence interval (CI) 1.02–1.32].
Wu 2005	Direct (medical and drugs) and indirect (work loss) annual costs associated with Atrial Fibrillation	AF vs no-AF	United States of America	Retrospective cohort study	Overall: n=7888 With AF: n=3944 Without AF: n=3944	The excess annual total cost of AF was \$14875 (p < 0.01), with AF patients approximately 5 times as costly as non-AF individuals (\$18454 versus \$3579, respectively). Total indirect cost due to work loss (due to medical services and disability) was \$2847 for AF patients vs \$713 for non-AF patients
Zwartkruis 2022	Association between 10-year incident AF and shift work	shift work vs standard working hours, Incident AF vs no AF	Norway	Prospective cohort study	Overall: n=22339 with Incident AF n=129 Without Incident AF n=22210	Shift work was not significantly associated with 10-year incident AF during 10 years of follow-up; 129 participants (0.6%) developed incident AF. Of all 10-year incident AF cases, 25 occurred in participants with shift work (incidence rate 0.59 per 1000 person-years) and 104 in participants without shift work (incidence rate 0.65 per 1000 person-years). Shift work is generally defined as any type of work that is done outside of conventional daytime working schedules

Meta-analysis Results

The three meta-analyses pooled data from 402,399 participants, including 1,728 AF patients and 1,576 controls. For incident AF over 10 years, 6,967 cases were identified against 383,323 controls.

Meta-analysis 1: Sex Disparities in Employment Outcomes

The pooled data from two studies (n=8,905) demonstrated a likely association between the odds of unemployment and sex among patients with AF. The result suggests that males with AF have 24% lower unemployment odds than the female sex (OR = 0.76, 95% CI: 0.65-0.86, $p < 0.0001$; Figure 6, Table 2). Despite weight differences, low heterogeneity was revealed ($I^2 = 0\%$, $p = 0.64$), meaning there was low variability in the results of the two studies present.

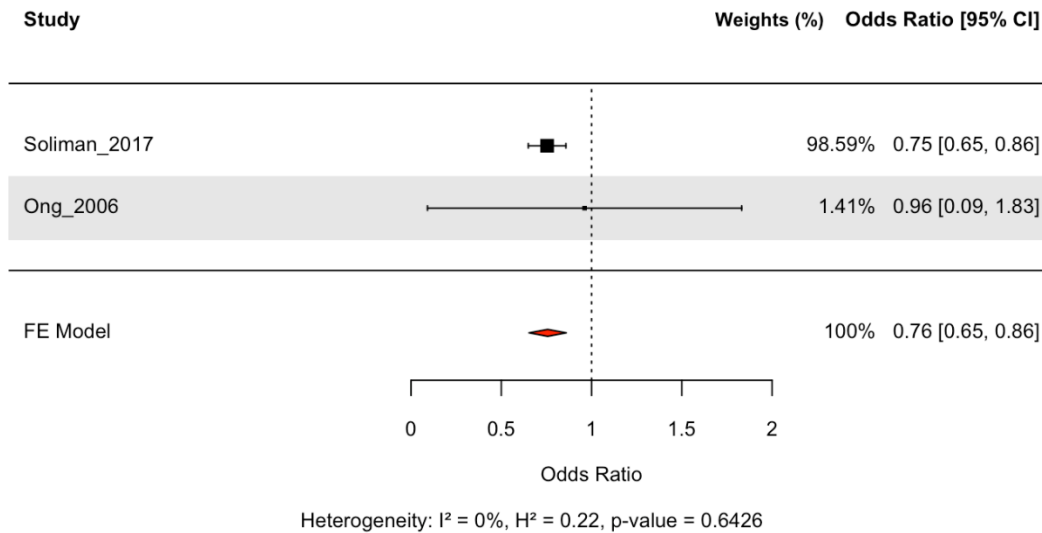


Figure 6: Meta-analysis of association between unemployment and sex (n=2 Studies)

Table 2: Association between Unemployment and Sex (N=2 Studies)

Study	Group	OR	CI_low	CI_up	SE	p	Participant n (male)	Participant n (female)	Participant n (total)
Soliman 2017	Sex	0.7539	0.6793	0.8368	0.0532	< 0.0001	3245	5567	8812
Ong 2006	sex	0.9615	0.40000	2.3115	0.44421	0.9302	61	32	93

Meta-analysis 2: Unemployment as a Risk Factor for AF

Three studies (n=3,204) examined the association between unemployment and the odds of AF. The pooled fixed effects model showed that unemployed individuals possibly had 44% higher odds of developing AF than their employed counterparts (OR 1.44, 95% CI 1.29 to 1.59; [Figure 7](#), Table 3). There was low heterogeneity between the studies ($I^2 = 0\%$, $p=0.9455$).

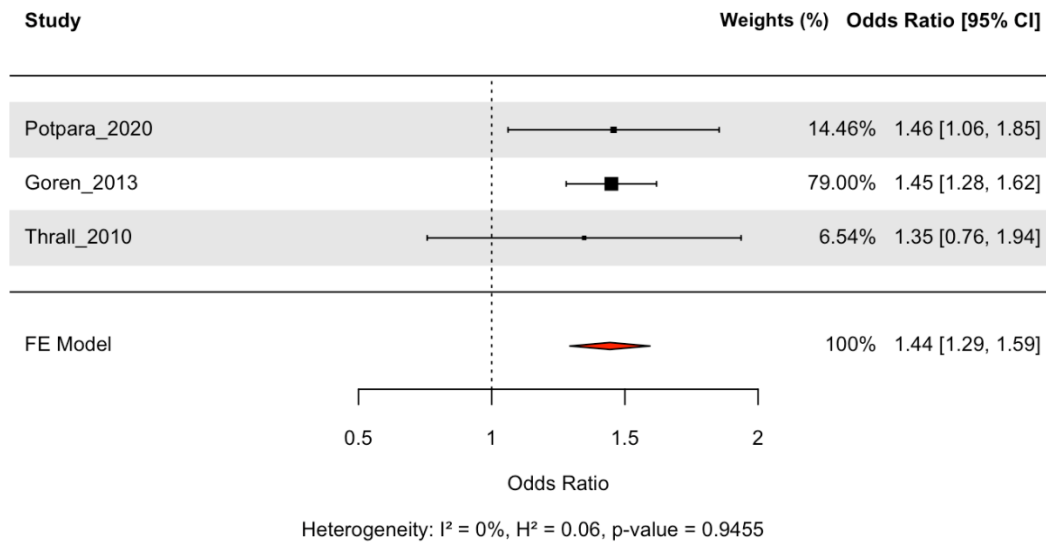


Figure 7: Meta-Analysis of Association Between Unemployment and AF (n=3 Studies)

Table 3: Meta-Analysis of Association Between Unemployment and AF (n=3 Studies)

Study	Group	OR	CI_low	CI_up	SE	p	Participant n (AF)	Participant n (No AF)	Participant n (Total)
Potpara 2020	AF	1.4575	0.9807	2.1663	0.2022	0.0624	331	183	514
Goren 2013	AF	1.4493	1.2233	1.7171	0.0865	0.0001	1296	1296	2492
Thrall 2007	AF	1.3471	0.7471	2.4288	0.3007	0.3218	101	97	198

Meta-analysis 3: Association between incident AF and Shift work.

The analysis of the three cohorts (n= 390,290) investigated the relationship between shift work (non-standard working hours) and the risk of incident AF during an average 10-year follow-up. The pooled fixed-effects model highlighted that shift work is associated with an 11% increased risk of AF compared to standard working hours (OR 1.11, 95% CI 1.05-2.17; [Figure 8, Table 4](#)). However, significant heterogeneity was observed ($I^2 = 9.59\%$, $p=0.0001$) and thus should be interpreted with caution.

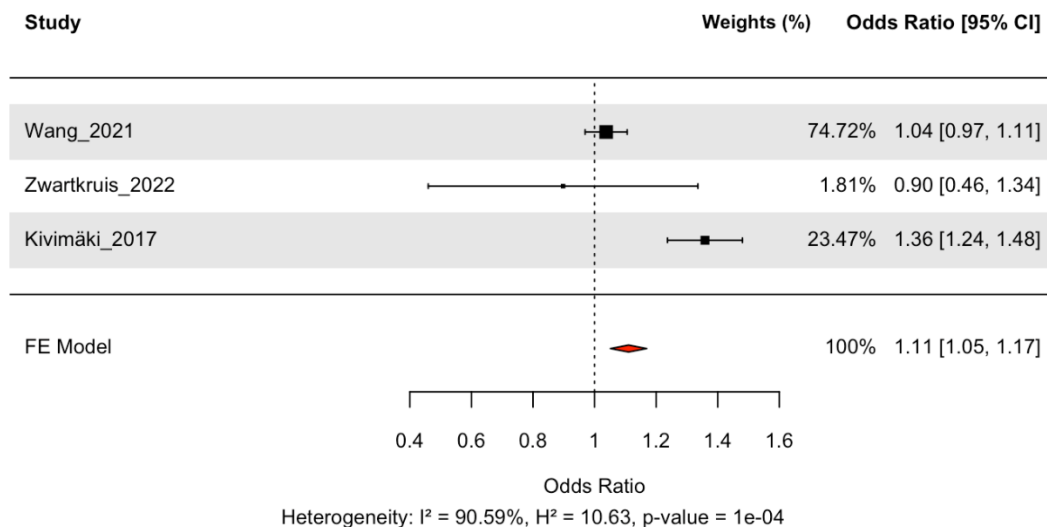


Figure 8: Meta-Analysis of Association Between Shift Work and AF (n=3 Studies)

Table 4: Meta-analysis of the association between shift work and AF (N=3 Studies)

Study	Group	OR	CI_low	CI_up	SE	p	Participant n (Incident AF)	Participant n (No incident AF)	Participant n (Total)
Wang 2021	AF	1.0376	0.9693	1.1107	0.0348	0.2881	5777	276680	282457
Zwartkruis 2022	AF	0.8977	0.5795	1.3908	0.2234	0.6291	129	22210	22339
Kivimäki 2017	AF	1.3586	1.2028	1.5346	0.0621	0.0001	1061	84433	85494

Discussion

This systematic review and meta-analysis sought to address three interrelated research questions:

RQ1: How does sex and gender impact employment outcomes in adult patients with atrial fibrillation (AF)?

RQ2: What types of employment outcomes are reported for individuals diagnosed with AF?

RQ3: To what extent is gender analysis included in current research on employment outcomes for AF patients?

By synthesizing quantitative and qualitative findings, this next section contextualizes the results within existing literature and theoretical frameworks outlined in the literature review.

A limitation in measuring employment outcomes across studies was the lack of standardized definitions of work limitations and health-related quality of life (HRQoL). A meta-analysis was also not performed for health-related quality of life (HRQoL) or quality of life (QoL) outcomes due to differences in measurement tools. For instance, Potpara et al. (2020) used the 5-item EQ-5D QoL questionnaire, Ong et al. (2006) employed the Medical Outcomes Study Short-Form 36 Health Survey while Dabrowski et al. (2010) assessed QOL using the Nottingham

Health Profile (NHP) questionnaire. Similarly, work activity impairment related to work was also measured inconsistently. While some studies, such as Goren et al. (2013), used general activity impairment measures to enhance generalizability, others employed more specific tools like the Work Productivity and Activity Impairment (WPAI) instrument. These methodological differences limited the comparability of quantitative QoL and work limitation data across studies.

The Gendered Impact of AF on Employment: RQ1.

The first research question explored how sex and gender shape employment outcomes in individuals with AF. The findings revealed sex disparities, with males having 24% lower odds of unemployment compared to females (OR = 0.76, 95% CI: 0.65–0.86). The review also found that gendered expectations can delay women’s return to work after illness, partly due to employment opportunities being constrained by caregiving responsibilities, unpaid labour, and societal expectations (Lyonette & Crompton, 2015).

This review’s synthesis also revealed that women with AF face added dual burdens—managing their health condition while simultaneously fulfilling unpaid caregiving roles. This echoes the literature on the “doing gender” framework (West & Zimmerman, 1987), which suggests that societal norms reinforce women’s disproportionate share of domestic labour.

These findings are not unique to AF but reflect broader labour inequities exacerbated by chronic illness, as demonstrated by research on COVID-19-related employment disruptions (Reichelt et al., 2021).

The literature on unpaid labour further underscores how caregiving responsibilities can delay women’s return to work, a finding reflected in this review’s synthesis (Ervin et al., 2022; Langer et al., 2015).

Further, despite the lack of universally accepted definitions of unpaid labour, particularly concerning patients with AF, the International Labour Organization (ILO) has established that unpaid care work significantly impacts workforce participation and job quality. The amount of unpaid labour women performs influences whether they enter, stay in, or leave paid employment (Ervin et al., 2022). This suggests that persistent inequities in unpaid labour distribution contribute to gender disparities in workforce participation, further impacting the challenges faced by AF patients seeking to maintain or return to employment. The global scope of unpaid labour suggests that three-quarters of all unpaid labour worldwide is performed by women, who invest 11 billion hours daily in caregiving and domestic work (Langer et al., 2015; Seedat & Rondon, 2021).

These findings further stress the need for workplace policies that recognize and address the intersection between unpaid caregiving, gender norms, and employment for individuals with AF. To address these gendered disparities, policy interventions must shift from reinforcing traditional gender roles to actively challenging and transforming them. As noted in the literature review, scholars such as Deutsch (2007) argue for “undoing gender,” moving beyond West and Zimmerman’s (1987) conceptualization of gender as an inescapable social construct. Instead, interventions could redefine labour policies to support a more equitable distribution of caregiving responsibilities. For example, this could look like flexible work arrangements for all employees, including remote work and adaptable hours, to accommodate caregiving duties. It could also encompass universal childcare and eldercare support, ensuring that caregiving does not disproportionately burden one gender and limit their employment opportunities.

Unemployment as a Risk Factor for AF: The Consequences of Unemployment: RQ2

The second research question examined the employment outcomes reported for individuals diagnosed with AF. The findings revealed a bidirectional relationship between AF and employment status. The meta-analysis indicated that unemployment was associated with a 44% higher risk of developing AF (OR = 1.44, 95% CI: 1.29–1.59). These results align with research on how social determinants of health can affect physical and mental health outcomes (Drydakis, 2015; Harkko et al., 2018). For research related to cardiovascular conditions and the connections related to unemployment, see also (Dupre et al., 2012; Gallo, 2012; Méjean et al., 2013; Meneton et al., 2015). This association may be explained by chronic stress, loss of socioeconomic status, and reduced access to healthcare, all pathways through which unemployment influences AF risk. As Soliman et al. (2017) found, uninsured individuals in the U.S. faced higher odds of AF-related unemployment, illustrating how structural inequities in healthcare worsen disparities. This aligns with McKee-Ryan et al. (2005) who argued that job loss leads to mental and physical health consequences.

The discussion of these gendered risks and AF risks highlights the need for policies that could reduce economic uncertainty, such as unemployment protections, mental health support, and reintegration programs for AF patients.

It is important to note, however, that researchers have speculated that epidemiological studies of unemployment and health are particularly challenging potentially due to the prospective "effect-cause" relations where unemployment is a consequence of poor health rather than vice versa. Further, confounding variables like education and income may predict both unemployment and poor health (Havranek et al., 2015; Schultz et al., 2018). However, abundant research points to the claim that job loss leads to illness, consistent with the results of this

review(Dupre et al., 2012; Gallo, 2012; Méjean et al., 2013; Meneton et al., 2015). Nevertheless, the discussion of these gendered risks and AF risks highlights the need for policies that could reduce economic uncertainty, such as unemployment protections, mental health support, and reintegration programs for AF patients.

Shiftwork

Another key employment outcome examined was the impact of shift work on AF risk. The meta-analysis (Figure 8, Table 4) found that shift work was associated with an 11% increased risk of AF (OR = 1.11, 95% CI: 1.05–2.17). This suggests that occupational exposure to irregular working hours could contribute to AF development, potentially through mechanisms such as sleep (N. J. Wang et al., 2021), increased stress, or altered cardiovascular regulation. This could be because of irregular working hours and the ability to adjust to environmental changes are disrupted, and the disruption in the circadian rhythm has a negative impact on an individual's biology and increases arrhythmia susceptibility (Charrier et al., 2017; N. J. Wang et al., 2021).

The literature review established that disrupted circadian rhythms and chronic stress are well-documented pathways linking shift work to cardiovascular disease (Charrier et al., 2017; Wang et al., 2021). However, the heterogeneity in definitions of “shift work” across studies and the significant heterogeneity ($I^2 = 9.59\%$, $p=0.0001$) in the meta-analysis limits the ability to draw definitive conclusions. Some studies categorized shift work strictly as night shifts (N. J. Wang et al., 2021) to irregular working hours that fall outside of the standard 9 am-5 pm and rotating shifts (Zwartkruis et al., 2022). This heterogeneity may also be explained by the varying country settings (i.e. Norway vs United Kingdom vs Denmark and Sweden).

This inconsistency raises policy questions. Are specific work schedules particularly harmful for AF patients? Future research could investigate occupational risk mitigation strategies.

Despite the heterogeneities across studies, the pooled results and definitions align with the broader literature on shiftwork and cardiovascular risk. For example, a systematic review of 21 studies with a total of 173,010 unique participants found that shift work was associated with a 26% increased risk of coronary heart disease (CHD) morbidity (Torquati et al., 2018).

Gap in Gender Analysis: RQ3

The third research question examined the extent to which gender analysis is included in employment research on AF. This systematic review revealed a gap in gender analysis in research, as most studies focused solely on sex-based comparisons without exploring the broader sociocultural dimensions of gender. This aligns with critiques from researchers who argue that medical research often conflates sex and gender (CIHR, 2023; Heise et al., 2019; Lips, 2020), overlooking the lived experiences of non-binary and transgender individuals (Benjamin et al., 2023). Only a few such as (Ong et al., 2006; Sultan-Taïeb et al., 2022; Thrall et al., 2007) explicitly considered gender and reported that men and employed individuals had better QoL outcomes than women and unemployed counterparts.

Conclusion: Policy Implications and Future Direction

To the best of our knowledge, this systematic review and meta-analysis is the first to explore the intersection of atrial fibrillation (AF), sex, gender, and employment outcomes.

The review began by highlighting the significant burden of AF on patients' quality of life (QoL), as evidenced in studies like Potpara et al. (2020) and Ong et al. (2006) and situating these findings within the theoretical framework of "doing gender" (West & Zimmerman, 1987) and

“undoing gender”. This research highlights the extent to which caregiving burdens and systemic inequities can diminish workforce participation—particularly for women.

The meta-analysis revealed that males with AF had 24% lower odds of unemployment compared to females (OR = 0.76, 95% CI: 0.65–0.86), reflecting systemic gender inequities in workforce retention (Lyonette & Crompton, 2015). Additionally, unemployment increased the risk of AF by 44% (OR = 1.44, 95% CI: 1.29–1.59), underscoring the bidirectional relationship between employment loss and cardiovascular health. Shift work was associated with an 11% increased risk of AF (OR = 1.11, 95% CI: 1.05–2.17), though substantial heterogeneity ($I^2 = 90.59\%$) was noted.

The review showed that most studies conflated sex and gender, a critique echoed in the literature by CIHR (2023) and Heise et al. (2019), who provide guidelines urging researchers to distinguish biological from sociocultural factors. As noted, the findings emphasize the need for workplace policies that provide flexible working arrangements, caregiving support, and equitable opportunities for AF patients to participate in the labour market without compromising their health. In line with Deutsch’s (2007) notion of “undoing gender”, policies that challenge traditional gender roles, such as universal childcare support and flexible work hours, could reduce the burden on women with AF and promote more equitable employment outcomes.

The findings ultimately address three key research questions:

RQ1: How does sex and gender impact employment outcomes in adult patients with atrial fibrillation (AF)?

RQ2: What types of employment outcomes are reported for individuals diagnosed with AF?

RQ3: To what extent is gender analysis included in current research on employment outcomes for AF patients?

By answering these questions, this study highlights the need for evidence-informed policies and interventions that support AF patients in the workplace.

Limitations

Other than the limitations present in current literature, it is important to recognize and consider the limits of this meta-analysis.

Firstly, measurement bias may exist due to the reliance on self-reported employment status and AF diagnosis in several studies (e.g., (Goren et al., 2013; Thrall et al., 2007)). Self-reported data may misclassify employment status or underestimate AF prevalence, particularly in populations with limited healthcare access. This could be because the lack of insurance may lead to less discovery of AF due to visiting a medical professional less often or human error in the case of employment status. Relatedly, the data were potentially geared toward paid labour and economically active cohorts and excluded the non-working population like homemakers and retirees as seen in Soliman et al. (2017). Additionally, AF diagnosis methods varied across studies. While some used gold-standard electrocardiograms (ECG), others relied on hospital records, death records or medication reimbursements (Kivimäki et al., 2017; N. J. Wang et al., 2021) introducing heterogeneity in AF case discovery.(Chen et al., 2024). Moreover, the matched control groups were not entirely free from other cardiovascular diseases (CVDs). In Potpara et al. (2020), the control group consisted of patients without AF but with hypertension, while in Thrall et al. (2007), the control group included individuals with other chronic conditions, such as cardiovascular and pulmonary diseases, diabetes mellitus, and other comorbidities. This overlap between AF and other cardiovascular conditions may have influenced employment outcomes and

quality of life comparisons, potentially underestimating or overestimated the specific impact of AF on employment due to the shared burden of multimorbidity.

Secondly, the lack of data on sex and gender and the potential conflation in studies could obscure intersectional disparities and limited intersectional analysis.

Thirdly, another possible limitation due to the limited research in this topic is the low number of articles included in this study, although the included studies often had large sample sizes.

Finally, heterogeneity in definitions of shift work and employment across studies could weaken comparability mirroring challenges noted by (Wang et al., 2021; Zwartkruis et al., 2022).

Future Research:

Several future research avenues appear in light of these findings and limitations.

Future research should prioritize using standardized definitions for employment outcomes, shift work, and AF diagnosis to improve cross-study comparability. Using international labour classifications (e.g., International Labour Organization's employment classifications standards) or ECG confirmation for AF would improve cross-study comparability and yield more substantial evidence for employment-based policy interventions (Valarino, 2018). These measures would support more vigorous meta-analyses, inform policy decisions and help ensure evidence reliability on AF-related employment outcomes.

Secondly, given the conflation of sex and gender in existing studies, future work should explicitly differentiate these constructs and incorporate intersectional analyses that account for additional factors, including race, socioeconomic status, and cultural context.

Lastly, researchers should collaborate with policymakers and employers to design, implement, and evaluate interventions that address AF patients' unique challenges. This study's

explored examples including stress management programs, flexible scheduling, universal childcare supports, and occupational health guidelines for shift workers. Prospective cohort studies that track AF patients over time could better illuminate the causal pathways between employment changes and cardiovascular risk, taking into account confounding variables such as education, income, and community support.

To conclude, by considering this research and future directions, researchers, practitioners, and policymakers can better understand AF, sex, and gender-related disparities and develop targeted strategies that support workforce participation and long-term health outcomes for patients with Atrial Fibrillation.

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Appendix A: Data Extraction by Study

Table 5: List of Data Extractions by Study

BerntJørgensen 2023

Study Identification				
Sponsorship source	Danish Ministry of Health (the ‘Activity funds’)			
Country	Denmark			
Setting				
Comments				
Authors name	Sidsel Marie Bernt Jørgensen			
Institution	Danish Heart Foundation, Section of Cardiovascular Research, Vognmagergade 7, 3rd Floor, 1120, Copenhagen K, Denmark			
Email	sidselmrj@hjerteforeningen.dk			
Address				
Study Start date	2014			
Study End date	2021			
Other				
Methods				
Design	Retrospective cohort study			
Population				
Inclusion criteria	people over thirty-five who had a hospital admission (in- or outpatient contact) in 2018 with a discharge diagnosis of atrial fibrillation (AF), Denmark residents			
Exclusion criteria	people who stated that they were not diagnosed with CVD in 2018			
Group differences				
Total sample size	842			
Interventions				
	male (age 32-55)	male (Age 56-85)	Female (F Age 56-85)	Female (F age 32-55)
Number of participants allocated	96	191	46	29
Outcomes				

Probability of feeling under pressure to return to work				
	Baseline			
	mean	Lwr CI	Upp CI	N
male (age 32-55)	29	21.3	40.4	96
male (age 56-85)	35	13.1	35.6	191
Female (F age 56-85)	12	14.3	41.1	46
Female (F age 32-55)	15	32.5	70.6	29

BerntJørgensen 2023

Study Identification		
Sponsorship source	Hjerteforeningen; Nordea-fonden	
Country	Denmark	
Setting		
Comments		
Authors name	Sidsel Marie Bernt Jørgensen	
Institution	Department of Public Health & Center for Healthy Aging, Øster Farimagsgade 5, 1353 Copenhagen K, Denmark; The Danish Heart Foundation, Section of Cardiovascular Research, Vognmagergade 7, 3rd Floor, 1120 Copenhagen K, Denmark	
Email	sidselmrj@hjerteforeningen.dk	
Address	Vognmagergade 7, 3rd Floor, Copenhagen K, 1120, DK	
Study Start date		2018
Study End date		
Methods		
Design	Retrospective cohort study	
Group		
Other	<p>Return to work was defined as being self-supporting (not receiving public social welfare benefits, e.g. sick leave benefits or unemployment benefits) for at least four consecutive weeks. Return to work was measured in two ways: (i) having worked for four consecutive weeks within 1 year after CVD diagnosis and (ii) being back at work for four consecutive weeks in the last week for a given period (3, 6, or 12 months after diagnosis).</p> <p>For individuals who returned to work within 1 year after the date of diagnosis, they examined the probability of detachment from employment after initial return during a six-months follow-up period. Detachment was defined as not being self-supporting but receiving public benefits of any duration [grouped into sick leave benefit, unemployment benefit or other benefit, and pension (including disability pension)]. In addition, individuals who emigrated or died were defined as being detached from employment</p>	
Study aims	<p>To identify people in particular need of vocational rehabilitation, they examined differences in return</p> <p>To identify people in particular need of vocational rehabilitation, they examined differences in return to work and subsequent detachment from</p>	

	employment among people with atrial fibrillation (AF), heart failure (HF), heart valve disease, and ischaemic heart disease.	
Population		
Inclusion criteria	Atrial fibrillation (AF), heart failure (HF), heart valve disease, and ischaemic heart disease. 35-65 Not receiving social welfare.	
Exclusion criteria	individuals diagnosed with the same diagnosis within the previous 10 years	
Group differences		
Total sample size	Overall= 8187 With AF= 2568 (31.4%) Other CVD (heart failure (HF), heart valve disease, and ischaemic heart disease) =5601	
	Overall	
Mean age (years) \pm SD	55.1	
n (%) with Atrial Fibrillation	31.4%	
n (%) Employed	2571 (31.4% x 8189)	
Interventions		
	male	Female
Number of participants allocated	1936	632

Dąbrowski 2010

Study Identification					
Sponsorship source	No sponsorship source was identified.				
Country	Warsaw, Poland				
Authors name	Rafał Dąbrowski, Edyta				
Institution	Institute of Cardiology, Warsaw, Poland				
Email	rdabrowski45@gmail.com				
Address	Institute of Cardiology, 2nd Ischaemic Heart Disease Department, ul. Spartańska 1, 02-637 Warszawa, Poland,				
Methods					
Design	Case-control study				
Group					
Other	Work (defined as paid employment), household activities (cleaning, cooking, small repairs),				
Study aims	To evaluate quality of life and depression level in patients with various patterns of AF.				
Population					
Inclusion criteria	Adults over 18 including 55 women (mean age 67.8±10.5 years) and 95 men (mean age 64.1 ± 9.5 years) with different forms of AF)				
Exclusion criteria	patients with AF due to valvular heart disease, with valve prosthesis, cardiomyopathy, heart failure or left ventricular dysfunction (ejection fraction < 55%).				
Group differences	The control group included 70 "healthy" people (mean age 55.5 ± 14.5 years),				

Total sample size	Overall: n= 220 With af: n= 150 With No Af (control group): n= 70				
Number of withdrawals					
Reason for withdrawals					
Other					
	Male	Female	AF	No AF	Overall
Mean age (years) ± SD			67.8±10.5 years	56.5 ± 13.3 years	1
n (%) with Atrial Fibrillation	95	55			150 (68%)
Interventions					
	male	Female	AF	No AF	
Number of participants allocated	With Af=95, Without=30	With Af=55, Without=40	150	70	
Outcomes					
Work Limitation (%)					
	Baseline				
	OR	Lwr CI	UPP CI	P-value	N
No AF vs AF	3.1895	1.4629	6.954	0.0035	220

DeBacquer 2000

Study Identification		
Sponsorship source	N/a	
Country	Belgium	
Setting	Four large epidemiological studies performed in Belgium.	
Comments	Being currently employed was associated with a lower prevalence of minor and T wave abnormalities and consequently with a lower prevalence of ischaemic ECG findings.	
Authors name	D De Bacquer	
Institution	Department of Public Health, University of Ghent, De Pintelaan 185, B-9000 Gent, Belgium. dirk.debacquer@rug.ac.be	
Email	dirk.debacquer@rug.ac.be	
Address	De Pintelaan 185, Gent, B-9000, BE	
Study Start date		1978
Study End date		1993
Methods		
Design	Cross sectional Study	
Group		
Other	The impact of employment status was investigated by comparing subjects in regular employment with those not in regular employment.	
Study Aims	To obtain accurate estimates of the prevalence of ECG abnormalities in the general population and to describe them in relation to employment.	
Population		
Inclusion criteria	four large epidemiological studies performed in Belgium during the past 30 years: - The Belgian heart disease prevention project (BHDPP) - Belgian interuniversity research on nutrition and health (BIRNH) - The MONICA (monitoring trends and determinants in cardiovascular disease) project -the Belgian job stress project (BELTRESS)	
Total sample size	47 358	
	Overall	
Mean age (years) ± SD	25-75	
Interventions		
	male	Female
Number of participants allocated	34 731	12 637
Outcomes		
Other (Association between ECG findings and employment)		

Latif 2023

Study Identification					
Sponsorship source	Creighton University				
Country	United States				
Setting					
Comments					
Authors name	Azka Latif				
Institution	Department of Cardiovascular Medicine, Baylor College of Medicine, Houston, TX, United States of America				
Email	drazka.latifmd@gmail.com				
Study Start date	2018				
Study End date					
Other	Conflict of Interest: The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Michael H. Kim, MD, MMM reports a relationship with Sanofi that includes consulting or advisory.				
Methods					
Design	Retrospective cohort study				
Study aims	To assess whether all-cause 30-day hospital readmission following AF- specific hospitalization is associated with health-related social needs (HRSN) using a large, nationally representative hospital readmissions database.				
Population					
Inclusion criteria	Hospitalizations for patients at least 18 years of age with a primary discharge diagnosis of AF and secondary diagnoses for five HRSN domains.				
Exclusion criteria	Minors No Af				

Total sample size	1,807,460 index hospitalizations in the United States included a primary discharge diagnosis of AF 16,879 with Af and HRSN domain as a secondary diagnosis.				
Interventions					
	male	Female			
Number of participants allocated	116.9	83.1			
Outcomes					
Association of Employment Status with AF (Association between employment and all-cause 30- day readmissions by biological sex)					
	Baseline				
	OR	Lwr CI	Upp CI	N	p-value
male vs Employed	1.18	0.85	1.62	117	0.32
Female vs Employed	1.01	0.62	1.63	83	0.974
Unemployed vs Employed					

Potpara 2013

Study Identification								
Sponsorship source								
Country	Serbia; United Kingdom							
Setting	Belgrade Atrial Fibrillation Study registry.							
Comments								
Authors name	Tatjana Potpara							
Institution	Faculty of Medicine, University of Belgrade, Serbia; Cardiology Clinic, Clinical Center of Serbia, Belgrade, Serbia.							
Email	tanjapotpara@gmail.com							
Address	Visegradska 26, Belgrade, 11000, SR							
Study Start date	1992							
Study End date	2007							
Other								
Methods								
Design	Prospective cohort study							
Group								
Other								
Study aims	investigate patient attitudes towards AF							
Population								
Inclusion criteria	Patients with newly diagnosed AF in the Belgrade Atrial Fibrillation Study registry.							
Exclusion criteria	Patients with acute causes of AF (e.g., acute myocardial infarction, hyperthyroidism, fever, severe anemia), ventricular pre-excitation, atrial flutter, valvular heart disease, prosthetic valves, a history of rheumatoid fever, known malignancy, or any advanced							

	serious chronic disease were excluded							
Group differences	There were no significant differences between patients in the questionnaire group compared with the rest of the newly diagnosed AF cohort, except for slightly more male patients, a greater prevalence of hypertension, and more frequent use of oral anticoagulants in the questionnaire group							
Total sample size	390							
	Overall							
Mean age (years) ± SD	52.5 ± 12.2							
Interventions								
	male	Female	Employed	Other (Retired)	Other (No Spouse Group)	Other (Spouse Group)	Other (Negative Influence on Career)	Other (No Negative Influence on Career)
Number of participants allocated	688	371	171	219	73	316	267	354

Soliman 2017

Study Identification					
Sponsorship source	U.S. Department of Health and Human Services; National Institutes of Health; National Institute of Neurological Disorders and Stroke				
Country	United States of America				
Setting					
Comments					
Authors name	Elsayed Z. Soliman				
Institution	Department of Internal Medicine, Section on Cardiology, Wake Forest School of Medicine, Winston-Salem, North Carolina; Epidemiological Cardiology Research Center (EPICARE), Department of Epidemiology and Prevention, Wake Forest School of Medicine, Wins...				
Email	esoliman@wakehealth.edu				
Address	Medical Center Boulevard, Winston Salem, NC, 27157				
Study Start date	2003				
Other					
Methods					
Design	Prospective cohort study				
Group					
Other	Perceived stress measured by the Cohen Perceived Stress 16-point Scale.				
Study aims	to examine the association between involuntary unemployment and AF				
Population					
Inclusion criteria	Employed, self-employed, employed for wages, unemployed				
Exclusion criteria	unemployed voluntarily (retired (n = 8,655), homemaker (n = 1,046), and student (n = 47)),				
Group differences					
Total sample size	8192				
Number of withdrawals					
Reason for withdrawals					
Other					

	male	Female	Employed	Unemployed	Overall
Mean age (years) ± SD			58.0 6± 7.8	58.0 ± 7.8	p 0.002
n (%) with Atrial Fibrillation					673 (7.6%)
n (%) Employed					6717
n (%) Unemployed					2095
Insurance					
Other Socioeconomic factors					
n (%) Benefits/supports					
n (%) (Female)					
Interventions					
	male	Female	Employed	Other (Income ≤\$20)	Other (Income \$20-74)
Number of participants allocated	3,245	5,567	2095	1379	4427
Outcomes					
Association of Employment Status with AF					
	Endpoint				
	OR	Lwr CI	Upp CI	P- value	N
male	2.12	1.38	3.26	0.87	3225
Female	1.4	1.02	1.93	0.87	5567
Employed					6717
Other (Income ≤\$20)	1.34	0.82	2.19	0.66	1379
Other (Income 20-74)	1.99	1.44	2.75	0.66	
Other (Income 75k and above)	1.25	0.53	2.95	0.66	
Unemployed					2095
Other (Insured)		1.32			
Other (Uninsured)		0.6		0.45	
Perceived Stress Score					
	Endpoint				
	OR	Lwr CI	UPP CI	P- value	N
Unemployed vs Employed	2.02	1.63	2.5	0.01	

Sultan-Taïeb 2022

Study Identification			
Sponsorship source	research was supported by the European Trade-Union Institute (ETUI) through an operating grant received from the European Union.		
Country	Canada		
Setting			
Comments			
Authors name	Hélène Sultan-Taïeb		
Institution	Université du Québec à Montréal = University of Québec in Montréal		
Email	Sultan_taieb.helene@uqam.ca		
Address	rue Sainte-Catherine Est, Montreal, QC H2X 1L7, Canada		
Study Start date		2015	
Study End date			
Other			
Methods			
Design	Cross sectional Study		
Group			
Other	Disability-Adjusted Life Years (DALY) rate=attributable DALYs 100 00/ 100 000 Employed population ÷15		
Study aims	estimate the annual burden of CVD and depression attributable to psychosocial work exposures in EU28 in 2015.		
Population			
Inclusion criteria	psychosocial work exposures for 28 EU member states		
Exclusion criteria			
Group differences			
Total sample size	100,000 workers with outcomes (Cronary/ischemic heart diseases (CHD), stroke, atrial fibrillation, peripheral artery disease and depression)		
Outcomes			
Long working hours (Burden of AF attributable to Long Working hors)			
	Lwr CI	Upp CI	N
male	401	2993	1697
Female	54	454	254

Thrall 2007

Study Identification						
Sponsorship source	N/A					
Country	United Kingdom					
Authors name	Graham Thrall					
Institution	University Department of Medicine, City Hospital, Birmingham, UK					
Email	g.y.h.lip@bham.ac.uk					
Address	Birmingham, B18 7QH, GB					
Study Start date						
Study End date						
Other	The authors had no conflict of interest to declare.					
Methods						
Design	Cross sectional Study					
Study aims	To examine the prevalence and persistence of depression and anxiety in patients with atrial fibrillation (AF), and their effect on future quality of life (QoL) status.					
Population						
Inclusion criteria	All consecutive patients with a diagnosis of AF attending a specialist AF cardiology clinic were eligible for inclusion.					
Exclusion criteria	Patients were excluded for the following: (1) age less than 18 years; (2) previous nonpharmacologic intervention (excluding direct current cardioversion) to					

	correct this arrhythmia; (3) malignancy of any type; (4) myocardial infarction, transient ischemic attack/ stroke, coronary artery bypass graft surgery, or percutaneous coronary angioplasty within the previous 6 months; (5) not able to read English.					
Group differences	AF patients vs hypertensive patients.					
Total sample size						
Number of withdrawals						
Reason for withdrawals						
Other						
	male	Female	AF	No AF	Overall	
Mean age (years) ± SD					66.3	
n (%) with Atrial Fibrillation	62	39				
n (%) Employed			38	30	30	
n (%) Unemployed			63	67		
Insurance						
Other Socioeconomic factors						
n (%) Benefits/supports						
n (%) (Female)						
Interventions						
	male	Female	Employed	Unemployed	AF	No AF
Number of participants allocated	62	39	38 (AF)	63	101	97
Outcomes						
QOL						
	Baseline			midpoint (6 months)		
	mean	SD	N	mean	SD	
AF	20.4	5.7		20.3	6.2	
No AF	19.9	5.3		20.5	6.2	

Zwartkruis 2022

Study Identification					
Sponsorship source	Dutch Heart Foundation (CVON RED-CVD, grant 2017-11). Outside of the submitted work, the authors disclosed the following financial support: RAdB reports grants from the Dutch Heart Foundation (CVON SHE-PREDICTS-HF, grant 2017-21; CVON RED-CVD, grant 2017-11; CVON PREDICT2, grant 2018-30; and CVON DOUBLE DOSE, grant 2020B005), leDucq Foundation (Cure PhosphoLambaN induced Cardiomyopathy) and the European				
Country	Norway				
Setting	municipality of Tromsø, Norway				
Comments	Shift work was not significantly associated with 10-year incident AF. During 10 years of follow-up, 129 participants (0.6%) developed incident AF. Of all 10-year incident AF cases, 25 occurred in participants with shift work (incidence rate 0.59 per 1000 person-years) and 104 in participants without shift work (incidence rate 0.65 per 1000 person years).				
Authors name	Victor W Zwartkruis				
Institution	Department of Cardiology, University Medical Center Groningen, University of Groningen, Groningen, The Netherlands				
Email	m.rienstra@umcg.nl				
Address					
Study Start date	1986				
Study End date	2016				
Methods					
Design	Prospective cohort study				
Group					

Other	<p>follow-up duration was calculated as the time from the first attended survey to the date of incident AF, censoring due to migration or death or the end of the follow-up period (31 December 2016), whichever came first.</p> <p>During 10 years of follow-up, 129 participants (0.6%) developed incident AF. Of all 10-year incident AF cases, 25 occurred in participants with shift work (incidence rate 0.59 per 1000 person-years) and 104 in participants without shift work (incidence rate 0.65 per 1000 person years)</p>				
Study aims	if shift work is also associated with incident atrial fibrillation (AF) and if this association differs, depending on sex and age.				
Population					
Inclusion criteria	<p>Participants from the general population, who are invited based on birth cohorts and random cohorts. data from the Tromsø3 (1986–1987), Tromsø4 (1994–1995), Tromsø5 (2001) and Tromsø6 (2007–2008) surveys.</p> <p>all participants with paid work who attended at least one of these four surveys (n=24 535).</p>				
Exclusion criteria	participants with insufficient data on AF or in whom it was unclear whether they developed AF or not (n=1066), participants with prevalent AF at baseline (n=43) and participants without available data on shift work (n=1062),				
Group differences					
Total sample size	(n=24 535-2196=22 339 participants)				
Number of withdrawals	2196				
Reason for withdrawals	participants with insufficient data on AF or in whom it was unclear whether they developed AF or not (n=1066), participants with prevalent AF at baseline (n=43) and				

	participants without available data on shift work (n=1062),				
Other					
	Other (Shift work)	Other (No shift work)			
Mean age (years) ± SD	37.4±9.9	37.4±9.9			
n (%) (Female)	8544 (48%)	8544 (48%)			
Interventions					
	Other (Shift work)	Other (No shift work)			
Number of participants allocated	4716	17 623			
Outcomes					
Association of Employment Status with AF (association between shift work and 10-year incident AF)					
	OR	Lwr CI	Upp CI	N	p-value
Other (Shift work) vs Other (No shift work)	0.8977	0.579	1.3908	22339	0.6291

Gurusamy 2019

Study Identification				
Sponsorship source	This study was funded by Bayer AG.			
Country	Sweden, Germany			
Setting				
Comments				
Authors name	Venkatesh Kumar Gurusamy			
Institution				
Email	pareen.vora@bayer.com			
Address				
Study Start date	2011			
Study End date	2014			
Other				
Methods				
Design	cross-sectional study.			
Group				
Other				
Study aims				
Population				
Inclusion criteria	All patients aged ≥ 18 years with a diagnosis of NVAF in the National Swedish Patient register and a first prescription for a NOAC or warfarin in the Swedish Dispensed Drug Register between 01 December 2011 (when the first NOAC became available in Sweden), and 31 December 2014 were identified.			
Exclusion criteria	<p>The authors excluded patients with a diagnosis of mitral stenosis and those with mechanical heart valve prostheses because these conditions constitute mandatory indications for warfarin only.</p> <p>Patients who had previously received any oral anticoagulant from 1 July 2005 up to the index date.</p>			
Group differences	NOAC or warfarin			
Total sample size	68,056 patients with a diagnosis of NVAF and a first prescription for a NOAC or warfarin.			
Number of withdrawals				
Reason for withdrawals				
Other				

	Other (Treatment (NOAC))	Other (Treatment (Warfarin))		
Mean age (years) ± SD	74.4 ± 11.1	73.7 ± 10.7		
n (%) Employed	4727	10306		
n (%) Unemployed	13765	38873		
Interventions				
	Other (Treatment (NOAC))	Other (Treatment (Warfarin))	Employed	Unemployed
Number of participants allocated	18638	4918	15033	52638
Outcomes				
Association of Employment with Treatment				

Appendix B: PRISMA 2020 Checklist

Table 6: PRISMA 2020 Checklist (*Page et al., 2021*)

Topic	No.	Item	Reported?
TITLE			
Title	1	Identify the report as a systematic review.	Yes
BACKGROUND			
Objectives	2	Provide an explicit statement of the main objective(s) or question(s) the review addresses.	Yes
METHODS			
Eligibility criteria	3	Specify the inclusion and exclusion criteria for the review.	Yes
Information sources	4	Specify the information sources (e.g. databases, registers) used to identify studies and the date when each was last searched.	Yes
Risk of bias	5	Specify the methods used to assess risk of bias in the included studies.	Yes
Synthesis of results	6	Specify the methods used to present and synthesize results.	Yes
RESULTS			
Included studies	7	Give the total number of included studies and participants and summarise relevant characteristics of studies.	Yes
Synthesis of results	8	Present results for main outcomes, preferably indicating the number of included studies and participants for each. If meta-analysis was done, report the summary estimate and confidence/credible interval. If comparing groups, indicate the direction of the effect (i.e. which group is favoured).	Yes
DISCUSSION			

Topic	No.	Item	Reported?
Limitations of evidence	9	Provide a brief summary of the limitations of the evidence included in the review (e.g. study risk of bias, inconsistency and imprecision).	yes
Interpretation	10	Provide a general interpretation of the results and important implications.	yes
OTHER			
Funding	11	Specify the primary source of funding for the review.	n/a
Registration	12	Provide the register name and registration number.	n/a

For more information, please see: www.prisma-statement.org

Appendix C

PubMed Search Strategy

- ((atrial fibrillation[Title/Abstract] OR afib[Title/Abstract]) OR (atrial fibrillation[MeSH Terms] OR afib[MeSH Terms])) AND ((employment[Title/Abstract] OR work[Title/Abstract] OR career[Title/Abstract] OR labor[Title/Abstract] OR unemployment[Title/Abstract]) OR (employment[MeSH Terms] OR work[MeSH Terms] OR career[MeSH Terms] OR labor[MeSH Terms] OR unemployment[MeSH Terms])) AND ((gender[Title/Abstract] OR gender identity[Title/Abstract] OR sex[Title/Abstract]) OR (gender[MeSH Terms] OR gender identity[MeSH Terms] OR sex[MeSH Terms]))
- 142 Results Returned.
- Query Results: [142](#)

Cumulative Index to Nursing and Allied Health Literature (CINAHL)

- (TI (employment OR work OR career OR labor OR unemployment) OR AB (employment OR work OR career OR labor OR unemployment) OR MH (employment OR work OR career OR labor OR unemployment)) AND (TI (atrial fibrillation OR afib OR af) OR AB (atrial fibrillation OR afib OR af) OR MH (atrial fibrillation OR afib OR af)) AND (TI (gender OR gender identity OR sex) OR AB (gender OR gender identity OR sex) OR MH (gender OR gender identity OR sex))

Web of Science:

- (TI=("atrial fibrillation" OR "afip" OR "AF") OR AB=("atrial fibrillation" OR "afip" OR "AF") OR TS=("atrial fibrillation" OR "afip" OR "AF")) AND (TI=("employment" OR "work" OR "career" OR "labor" OR "unemployment") OR

AB=("employment" OR "work" OR "career" OR "labor" OR "unemployment") OR
TS=("employment" OR "work" OR "career" OR "labor" OR "unemployment")) AND
(TI=("gender" OR "gender identity" OR "sex") OR AB=("gender" OR "gender
identity" OR "sex") OR TS=("gender" OR "gender identity" OR "sex"))

- Results returned- 204.
- Query results: <https://www.webofscience.com/wos/woscc/summary/d25832b3-2ee5-421e-b54f-61be4db6eb88-eab3c302/relevance/1>

Cochrane Library

- (("atrial fibrillation" or "afib" or "AF") and ("employment" or "work" or "career" or "labor" or "unemployment") and ("gender" or "gender identity" or "sex")).mp
- [mp=title, short title, abstract, full text, keywords, caption text]
- 317 results returned.

Appendix D: Quality Assessments

Newcastle - Ottawa Quality Assessment Scale- Cohort Studies (Wells et al., 2014)

Note: A study can be awarded a maximum of one star for each numbered item within the Selection and Outcome categories. A maximum of two stars can be given for Comparability

Selection

- 1) Representativeness of the exposed cohort
 - a) truly representative of the average ____ (describe) in the community *
 - b) somewhat representative of the average _____ in the community *
 - c) selected group of users eg nurses, volunteers
 - d) no description of the derivation of the cohort
- 2) Selection of the non-exposed cohort
 - a) drawn from the same community as the exposed cohort *
 - b) drawn from a different source
 - c) no description of the derivation of the non-exposed cohort
- 3) Ascertainment of exposure
 - a) secure record (eg surgical records) *
 - b) structured interview *
 - c) written self-report
 - d) no description
- 4) Demonstration that outcome of interest was not present at start of study
 - a) yes *
 - b) no

Comparability

- 1) Comparability of cohorts on the basis of the design or analysis
 - a) study controls for ____ (select the most important factor) *
 - b) study controls for any additional factor * (This criterion could be modified to indicate specific control for a second important factor.)

Outcome

- 1) Assessment of outcome
 - a) independent blind assessment *
 - b) record linkage *
 - c) self-report
 - d) no description
- 2) Was follow-up long enough for outcomes to occur
 - a) yes (select an adequate follow up period for outcome of interest) *
 - b) no
- 3) Adequacy of follow up of cohorts
 - a) complete follow up - all subjects accounted for *
 - b) subjects lost to follow up unlikely to introduce bias - small number lost - > ____% (select an adequate %) follow up, or description provided of those lost) *
 - c) follow up rate < ____% (select an adequate %) and no description of those lost
 - d) no statement

Newcastle Ottawa Quality Assessment For (12) Cohort Studies

Using the NOS scale for cohort studies, the included studies were assessed across categories of selection bias, comparability, and outcome, with scores determining overall quality. Most studies achieved Good quality ratings due to representative populations, appropriate control of confounding variables, secure exposure ascertainment, and sufficient follow-up periods. In contrast, studies like BerntJørgensen 2023, Potpara 2013, Potpara 2020, and Wu 2005 were rated Poor due to limitations such as self-reported or unclear outcomes, lack of baseline clarity, inadequate follow-up, and limited confounder control. More vigorous studies typically used population-based data, secure records, and robust statistical adjustments, while weaker studies lacked methodological rigour in these domains.

Table 7: Newcastle Ottawa Quality Assessment For (12) Cohort Studies

A H R Q		Total (max 9)
		Good
		7
Outcome (Max 3 Stars)	<u>Adequacy of follow-up of cohorts</u>	a) complete follow up - all subjects accounted for (negligible loss due to deaths/emigrations (which were captured as part of the outcome measures- so all participants were accounted for) *
	<u>Was follow-up long enough for outcomes to occur</u>	a) Yes (adequate follow up period for outcome of interest=1 year) *
	<u>Assessment of the outcome</u>	b) record linkage (record linkage to Denmark's nationwide DREAM database) *
Comparability (Max 2 stars)	<u>Comparability of the Cohorts on the basis of the design or analysis group</u>	a) study controls for (sex) *
	<u>Demonstration that outcome of interest was not present at start of the study</u>	a) yes (primary outcome was non-employment / detachment from employment. The authors included people who were employed at diagnosis) *
	<u>Ascertainment of the exposure</u>	a) secure record (Danish National Patient Registry (secure administrative/medical records) *
Selection Bias Assessment (Max 4 stars)	<u>Selection of the non-exposed cohort</u>	c) no description of the derivation of the non-exposed cohort
	<u>Representativeness of the exposed cohort</u>	b) somewhat representative of the average (working-age Danish National Patient Register adults with new CVD) in the community *
	<u>Author _ Year</u>	BerntLørgensen 2022
		poor
		3
Outcome (Max 3 Stars)	<u>Adequacy of follow-up of cohorts</u>	d) no statement
	<u>Was follow-up long enough for outcomes to occur</u>	a) no (no perspective follows up)
	<u>Assessment of the outcome</u>	c) self report (pressure to return to work was self-reported)
Comparability (Max 2 stars)	<u>Comparability of the Cohorts on the basis of the design or analysis group</u>	a) study controls for (sex) *
	<u>Demonstration that outcome of interest was not present at start of the study</u>	b) no (outcome of pressure to return to work was self-reported and was not clearly absent at baseline)
	<u>Ascertainment of the exposure</u>	a) secure record (Danish National Patient Registry *
Selection Bias Assessment (Max 4 stars)	<u>Selection of the non-exposed cohort</u>	c)
	<u>Representativeness of the exposed cohort</u>	b) somewhat representative of the average (working-age Danish National Patient Register *
	<u>Author _ Year</u>	BerntLørgensen 2023

A H R Q		Good	
Total (max 9)		7	
Outcome (Max 3 Stars)	a) complete follow up - all subjects accounted for-*	a) *	a) *
	a) yes (adequate follow-up period for outcome of interest=5.7 year) *	a) yes (adequate follow up period for outcome of interest=10 years) *	a) yes (adequate follow-up period for readmission- 30-day & 90-day readmission endpoint is standard) *
	b) record linkage (combined self-reported data on work stress at baseline with follow-up data on atrial fibrillation from nationwide registers)*	b) record linkage (AF identified via hospital records, drug reimbursement data, or death certificates) *	b) record linkage (Work-disability identified via robust national registers) *
Comparability (Max 2 stars)	a) study controls for (sex) *	a) study controls for (sex, socioeconomic status) **	a) study controls for (sex, comorbidities in logistic models) **
	a) yes (They excluded those with AF at baseline, so incidence was tracked)	a) yes*	a) yes (They focused on index hospitalization, tracking subsequent readmissions)
	c) written self-report (questionnaire)	c) written self-report (questionnaire)	a) secure record (HRSN status determined by ICD-10 secondary diagnoses) *
Selection Bias Assessment (Max 4 stars)	a) *	a) *	a) (Patients without HRSN codes came from the same NRD population.) *
	a) truly representative of the average (Swedish working population) in the community *	a) truly representative of the average population in the community (Large IPD-Work consortium cohorts from multiple countries in Western Europe) *	b) somewhat representative of the average (hospitalized AF patient) in the community (they used the US Nationwide Readmission Database (NRD)) *
	Author _ Year	Fransson 2018	Kivimäki 2017

AHRQ	Good	poor	poor	Good
Total (max 9)	9	2	2	9
Outcome (Max 3 Stars)	a) * a) yes (adequate follow up period - 15 months) *	d) no statement b) no	d) no statement b) no	a) * a) yes (adequate follow up period for outcome of interest=10 years) *
	b) record linkage (Readmissions identified via NRD claims— objective database.) *	1) Assessment of outcome	1) Assessment of outcome	b) record linkage (AF determined by study ECG plus medical history.) *
Comparability (Max 2 stars)	a) study controls for (sex, socioeconomic covariates) *	none	none	a) study controls for (socioeconomic, cardiovascular risk factors) **
	a) yes (They excluded those already on permanent social security benefits (outcome) at baseline)	b) no	b) no	a) yes (AF excluded at baseline)
Selection Bias Assessment (Max 4 stars)	a) secure record (Incident AF documented via secure hospital diagnosis records) *	a) secure record (Medical record) *	a) secure record (Medical record) *	b) structured interview (phone interview) *
	a) (matched general-population controls from the same registries) *	c) no description	c) no description	a)
	a) truly representative of the average (Danish) population in the community AF patients identified through nationwide Danish registries) *	b) somewhat representative of the average (newly diagnosed) in the community-single-center	b) somewhat representative of the average (newly diagnosed AF) in the community-single-center registry*	a) truly representative of the average US population in the community (REGards is a large US cohort study) *
Author _ Year	Lunde 2022	Potpara 2013	Potpara 2020	Soliman 2017

A H R Q		Good		Poor		Good	
Total (max 9)		8		6		8	
Outcome (Max 3 Stars)	b) Minimal subjects lost to follow-up unlikely to introduce bias *			d) no statement			b) Minimal subjects lost to follow-up unlikely to introduce bias *
	a) yes (adequate follow up period for outcome of			b) no			a) yes (adequate follow up period for outcome of interest=10 years) *
	b) record linkage (hospital records) *			b) record linkage (claims data) *			b) record linkage (ECG plus + medical diagnosis,) *
Comparability (Max 2 stars)	a) study controls for (demographics, genetic risk) **			a) study controls for (patient demographics & co-existing condition) **			a) study controls for (sex, risk factors) **
	a) yes (AF excluded at baseline)			no			a) yes (AF excluded at baseline)
	c) written self-report (questionnaire)			a) secure record (Medical Claims) *			c) written self report (questionnaire)
Selection Bias Assessment (Max 4 stars)	a) *			a) *			a) *
	a) truly representative of the average (Large Uk biobank) in the community *			b) somewhat representative (used privately insured administrative database) *			a) truly representative of average (Norwegian population in the community- Large Tromsø Study) *
	Author _ Year	Wang 2021		Wu 2005		Zwartkruis 2022	

Newcastle Ottawa Quality Assessment Scale (Adapted For Cross-Sectional Studies)

Selection: (Maximum 3 stars)

1) Representativeness of the sample:

- a) Truly representative of the average in the target population. * (all subjects or random sampling)
- b) Somewhat representative of the average in the target population. * (non-random sampling)
- c) Selected group of users.
- d) No description of the sampling strategy.

2) Non-respondents:

- a) Comparability between respondents and non-respondents' characteristics is established, and the response rate is satisfactory. *
- b) The response rate is unsatisfactory, or the comparability between respondents and non-respondents is unsatisfactory.
- c) No description of the response rate or the characteristics of the responders and the non-responders.

3) Ascertainment of the exposure (risk factor):

- a) Validated measurement tool. *
- b) Non-validated measurement tool, but the tool is available or described.
- c) No description of the measurement tool.

Comparability: (Maximum 2 stars)

- 1) The subjects in different outcome groups are comparable, based on the study design or analysis. Confounding factors are controlled.
 - a) The study controls for the most important factor (select one). *
 - b) The study control for any additional factor. *

Outcome: (Maximum 2 stars)

1) Assessment of the outcome:

- a) Independent blind assessment. *
- b) Record linkage. *
- c) Self-report.
- d) No description.

2) Statistical test:

- a) The statistical test used to analyze the data is clearly described and appropriate, and the measurement of the association is presented, including confidence intervals and the probability level (p value). *
- b) The statistical test is not appropriate, not described or incomplete.

Note: This scale has been adapted from the Newcastle-Ottawa Quality Assessment Scale (NOS) designed initially for cohort and case-control studies to assess the quality of cross-

sectional studies in the systematic review and meta-analysis titled “*Intersectional Impacts of Sex and Gender on Employment Outcomes in Patients With Atrial Fibrillation.*” This modified version is based on the adaptation by Patra et al. (2015) and aligns with similar adjustments made in other studies aiming to evaluate cross-sectional research designs, including Blanchard et al. (2024) and Modesti et al (2016), among others.

Newcastle Ottawa Quality Assessment (Adapted For (6) Cross-Sectional Studies)

Using the adapted NOS for cross-sectional studies, the six articles vary in quality. Most studies scored well for comparability and statistical reporting, while differences mainly arose in the Selection category (i.e., representativeness, nonresponse) and outcomes assessment. Table 7 below is a brief rationale for each scale domain.

Table 8: Newcastle Ottawa Quality Assessment (Adapted For (6) Cross-Sectional Studies)

Author Year	Selection Bias Assessment (Maximum 5 stars)			Comparability (Maximum 2 stars)	Outcome (Maximum 3 Stars)	Total Score (MAX 7 Stars)	(AHRQ standards)
	Representativeness of the sample	Non-respondents	Ascertainment of the exposure (risk factor)				Confounding factors are controlled
DeBacquer 2000	a) Truly representative of the average AF patient in Belgium (four large Belgian cohorts) *	c) No description of the characteristics of the responders and the non-responders.	a) Validated measurement tool (ECG) *	a) The study controls for (sex, region) **	b) Record linkage (ECG). *	6	Good
Goren 2013	b) Somewhat representative (internet-based 2009 US National Health and Wellness	c) No description of the characteristics of the responders and the non-responders.	a) Validated measurement tool. *	a) The study controls for (demographics, comorbidities) **	c) self-report	5	Fair

(AHRQ standards)		Good	Fair	Fair	Good
Total Score (MAX 7 Stars)		7	5	4	6
Outcome (Maximum 3 Stars)	Statistical Test	a) regression modelling: ORs, CIs & p-values) *	a) regression analyses with p-values/CIs reported. *	a) Bivariate analysis with p-values/CIs reported. *	a) analysis for DALY computations with CIs reported. *
	Assessment of the outcome	b) Record Linkage (National Dispensed Drug Register) *	c) self-reported outcomes	c) self-reported outcomes	b) Record linkage (Global Health Data Exchange database) *
Comparability (Maximum 2 stars)	Confounding factors are controlled	a) The study controls for (demographics, comorbidities, medication use) **	a) controlled for key factors (demographics, gender) **	a) controlled for factors (demographics) *	a) controlled for factors (demographics) multivariable logistic models to control for (, sex, demographics) **
	Ascertainment of the exposure (risk factor)	Authors used validated registry data (e.g. diagnosis definitions and drug dispensaries) *	a) Depression, anxiety, burden and QOL were determined through validated scales (SF-35, HADS (Hospital Anxiety and Depression Scale), University of Toronto AF Severity Scale) *	a) Depression, anxiety and QOL were determined through validated scales (Beck Depression Inventory (BDI), the Start-Trait Anxiety Inventory	a) psychosocial exposures from an established EU survey data *
Selection Bias Assessment (Maximum 5 stars)	Non-respondents	a) There was no “ non-registry-based” *	c) no description of the characteristics of all participants (non-responders and responders)	c) no description of the characteristics of non-responders	c) unclear description of the characteristics of non-responders
	Representativeness of the sample	a) Truly representative of the average AF patient in Sweden (three Swedish National Registries) *	b) Somewhat representative of AF (n=93) and Hypertensive patients n=97) from two tertiary care clinics*	b) Somewhat representative of AF patients from speciality clinics *	a) Truly representative of the average AF working population in Europe (28 European Union countries (EU28)
Author Year		Gurusamy 2019	Ong 2006	Thrall 2007	Sultan-Taieb 2022

Newcastle - Ottawa Quality Assessment Scale Case-Control Study)

Note: A study can be awarded a maximum of one star for each numbered item within the Selection and Exposure categories. A maximum of two stars can be given for Comparability.

Selection: (Maximum 3 stars)

- 1) Is the case definition adequate?
 - a) Yes, with independent validation *
 - b) Yes, e.g. record linkage or based on self-reports
 - c) no description
- 2) Representativeness of the cases
 - a) Consecutive or obviously representative series of cases *
 - b) Potential for selection biases or not stated
- 3) Selection of Controls
 - a) Community controls *
 - b) Hospital controls
 - c) No description
- 4) Definition of controls
 - a) No history of disease (endpoint) *
 - b) No description of source

Comparability: (Maximum 2 stars)

- 1) Comparability of cases and controls on the basis of the design or analysis
 - a) Study controls for _____ (Select the most important factor.) *
 - b) Study controls for any additional factor * (This criterion could be modified to indicate specific control for a second important factor.)

Exposure: (Maximum 2 stars)

- 1) Ascertainment of exposure
 - a) Secure record (eg surgical records) *
 - b) Structured interview where blind to case/control status *
 - c) Interview not blinded to case/control status
 - d) Written self-report or medical record only
 - e) No description
- 2) Same method of ascertainment for cases and controls
 - a) Yes *
 - b) No
- 3) Non-Response rate
 - a) Same rate for both groups *
 - b) Non respondents described
 - c) Rate different and no designation

(Wells et al., 2014)

Newcastle Ottawa Quality Assessment (Adapted For (1) Case-Control Study)

Table 9: Newcastle Ottawa Quality Assessment (Adapted For (1) Case-Control Study)

AHRQ		
Total Score (Max 10 Stars)		
4		
poor		
Outcome (Maximum 3 Stars)	<u>Non-Response rate</u>	c) The article does not specify any differential response, and it does not discuss how many refused to participate or did not complete questionnaires.
	<u>Same method of ascertainment for cases and controls</u>	a) yes, the same questionnaire was used for both the patient and control group*
	<u>Assessment of the exposure</u>	d) written self-report using validated scales
	<u>Comparability of the cases and control on the basis of the design or analysis group</u>	c) The authors note differences by sex and age in the final results but do not explicitly control for them across groups.
Comparability (Max 2 stars)	<u>Definition of controls</u>	a) no history of AF & major heart diseases*
	<u>Selection of Controls</u>	c) no description of how the “ healthy control group” was recruited
	<u>representatives of the cases</u>	a) patients came from single cardiology institution and were recruited consecutively *
	<u>Is the case definition adequate</u>	a) yes- the authors identified AF patients with ECG*
Selection Bias Assessment (Maximum 5 stars)		
Author_Year		Dąbrowski 2010

Criteria for converting the Newcastle-Ottawa scales to AHRQ standards

These Agency for Healthcare Research and Quality (AHRQ) standards (good, fair, poor) were adapted from (Langan et al., 2017)

Cohort and Case-Control Studies

Good quality

- 3 or 4 stars in selection domain AND 1 or 2 stars in comparability domain AND 2 or 3 stars in outcome/exposure domain

Fair quality

- 2 stars in selection domain AND 1 or 2 stars in comparability domain AND 2 or 3 stars in outcome/exposure domain

Poor quality

- 0 or 1 star in selection domain OR 0 stars in comparability domain OR 0 or 1 stars in outcome/exposure domain

Cross-sectional Studies

Good quality

- 2 or 3 stars in the Selection domain AND 1 or 2 stars in the Comparability domain AND 1 or 2 stars in the Outcome domain.

Fair quality:

- 2 stars in the Selection domain AND 1 or 2 stars in the Comparability domain AND 1 or 2 stars in the Outcome domain.

Poor quality

- 0 or 1 star in Selection domain OR 0 stars in Comparability domain OR 0 or 1 stars in Outcome domain.