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The Relationship of Obstructive Sleep Apnea with Cardiovascular Reactivity, Psychological Distress, and Coping Responses in the South African Context: A Critical Review

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Abstract

Obstructive sleep apnea (OSA) is known around the world to be one of the most common sleep disorders and a significant risk factor for cardiovascular morbidity and death, leading to significant changes in cognitive and daytime functioning, as well as several psychological and physiological challenges. This critical review research study aimed to review scientific literature in order to conceptualize an understanding of the relationship of OSA with both physiological (cardiovascular reactivity) and psychological aspects (psychological distress and coping responses), more specifically within the South African context. The literature search reviewed scientific literature that was peer-reviewed and published in the English language from 2012 to 2022. The SALSA (search, appraisal, synthesis, and analysis) method was used in order to examine the interplay between physiological and psychological aspects associated with OSA in South Africa. However, no studies within the South African context or internationally were found giving account for cardiovascular reactivity, psychological distress, and coping responses in relationship with OSA. Therefore, we provided a summary and discussion on available scientific literature in both the South African context and internationally, on each aspect separately related to OSA. We concluded that OSA has a significant impact on both the physiological and psychological well-being of individuals and it is necessary to gain a deeper understanding of the interplay between these aspects and OSA, in order to inform scientific knowledge and intervention strategies.

Keywords

Critical Review, Obstructive Sleep Apnea, Cardiovascular Reactivity,

Psychological Distress, Coping Responses, South African Context, International Context

1. Introduction

Obstructive sleep apnea (OSA) is a common and serious global health problem, both among young adults and children (Chang et al., 2020), characterized by disordered breathing during the sleep cycle which is caused by notable reductions in breathing (Franklin & Lindberg, 2015; Golbidi et al., 2012; Patel, 2019; Suri et al., 2023). Therefore, having an immense increase in the costs of health care due to a decrease in the quality of life (QoL) experienced by this group of individuals (Chang et al., 2020).

There is an increase in OSA cases, and it implicates all countries in the world (Alhumedy et al., 2023; Lyons et al., 2020). According to Blomster et al. (2015), OSA affects approximately 15% to 25% of working-aged individuals in the population at large. Benjafield et al. (2019) state that the most prevalent type of sleep disordered breathing, OSA, is expected to affect 1 billion of the world's 7.3 billion adults (population at the time) in the age range of 30 to 69 years and Senaratna et al. (2017) reported that the occurrence in the general world is considered to be between 9% and 38%. According to Roche et al. (2021), there is a concerning rise in the prevalence of OSA among South African communities, although there are no recent statistics available for the occurrence of OSA among the South African population. Furthermore, studies have found the prevalence of OSA in countries such as Nigeria and Pakistan are some of the highest worldwide, however, there are very limited studies reporting on the identification and management of OSA within the African and Asian continent as a whole (Lyons et al., 2020).

1.1. Obstructive Sleep Apnea and Cardiovascular Reactivity

Several studies have displayed the association between cardiovascular disease (CVD) and OSA (Banjade et al., 2023; Cao et al., 2023; Collen et al., 2020; Gao et al., 2023; Golbidi et al., 2012; Peker et al., 2023; Wang et al., 2023), however, certain hidden cardiovascular mechanisms have been associated with an increased risk of developing OSA. Sympathetic activation, also referred to as cardiovascular reactivity, has been suggested as a possible underlying mechanism for the link between OSA and CVD (Golbidi et al., 2012). Cardiovascular reactivity refers to how the cardiovascular system of the human body functions between cycles of rest and the occurrence of an external stressor (Cinciripini, 1986). The difference in measures such as heart rate (HR) and blood pressure (BP) are used to observe and conceptualize the reactivity of an individual based on physical activity, physical stressors, and cognitive stressors (Cinciripini, 1986). Even in milder types of OSA (Buchner et al., 2007), these negative consequences of OSA are major me-

diators of cardiovascular risk (Somers et al., 2008), hypertension (Lévy et al., 2015; Marin et al., 2012), coronary heart disease, stroke, and cardiovascular mortality (Blomster et al., 2015; Campos-Rodriguez et al., 2012) that have all been linked to OSA.

1.2. Obstructive Sleep Apnea and Psychological Distress

Tan et al. (2017) stressed that most patients with moderate to severe OSA go undiagnosed and are therefore not adequately treated, putting them at risk of serious CVD, as well as psychological difficulties (Jackson et al., 2011a). Recent advances in our understanding of the interplay between sleep and psychosocial factors such as depression, psychological stress, and close interpersonal relationships, as well as their possible downstream effects on the pathophysiology and clinical course of CVD, the leading cause of death worldwide, demonstrate the integration of psychology and sleep research (Roth et al., 2015). Previous research studies have confirmed that sleep disorders are a risk factor for psychological distress in the working population (Magnavita & Garbarino, 2017). According to Guglielmi et al. (2018), there exists an association between suspected OSA and psychological distress, such as depression, anxiety, insomnia, social dysfunction, and somatic symptoms as measured by the General Health Questionnaire (GHQ-28) (Goldberg & Hillier, 1979). Undiagnosed and untreated OSA has also been linked to decreased QoL and depression (Baldwin et al., 2001; Lee et al., 2015; Platon et al., 2023). There has also been evidence of increased demand for physician services, healthcare services, and expenses (Lyons et al., 2020). Furthermore, daytime drowsiness and lowered attentiveness are linked to poor job performance, lower productivity, and absence from work (Alghanim et al., 2008; Lyons et al., 2020; Saconi et al., 2020).

There is a large body of evidence indicating that there is a significant occurrence of depression and anxiety symptomatology in OSA (Jackson et al., 2011a; Jackson et al., 2011b; Rezaeitalab et al., 2014) with little reference to young adults specifically (Guglielmi et al., 2018) and none within the South African context taking into consideration gender and ethnicity. Depression and other prevalent mental illnesses, such as anxiety, are widespread in patients with clinical OSA (Bixler et al., 2017; Rezaeitalab et al., 2014). OSA symptoms such as poor nocturnal sleep quality and daytime tiredness have been demonstrated to negatively influence patients' psychological well-being and general QoL (Antic et al., 2011; Tsara et al., 2009).

1.3. Obstructive Sleep Apnea and Coping Responses

If OSA is not managed, it affects one's QoL, emotions, and day-to-day functions (Appleton et al., 2015; Jackson et al., 2011b), therefore it is essential to understand how individuals suffering from OSA cope with psychological distress in order to contribute to the effectiveness of treatment interventions. However, we are unaware of any previous research that has looked at the significance of cop-

ing techniques in OSA patients' depression symptoms, specifically in the South African context. Several studies have indicated the various coping strategies associated with OSA (Bardwell et al., 2001; Saconi et al., 2020; Vaishali et al., 2021), however, there is no available research, specifically in the South African context, indicating the relationship of OSA and coping strategies as described by the Coping Strategy Indicator (CSI). Several studies focused on the extent to which an individual employ certain coping strategy, as measured by the CSI, in response to a specific stressor and how it may be beneficial in coping with psychological distress, as well as chronic diseases such as OSA (Bardwell et al., 2001; Gassara et al., 2017). However, no specific studies investigating these specific relationships within the South African context and with specific reference to age, ethnicity, gender, and demographical aspects have been reported.

1.4. Goal of the Research Study

Roth et al. (2015) mention that integrating psychological and physiological investigations on sleep disorders are essential to advance our understanding of the interaction between physiological and psychological elements. As previously mentioned, untreated OSA puts patients at risk for severe cardiovascular disease and psychological challenges (Jackson et al., 2011a), therefore it is important to review both the physiological and psychological aspects related to OSA. Thus, this research study aimed to critically appraise and synthesize existing scientific literature on OSA with regard to psychological aspects (psychological distress and coping responses) and physiological aspects (cardiovascular reactivity) within the South African context. The research study aimed to address the following research questions: *What conclusions can be drawn from scientific literature regarding obstructive sleep apnea, cardiovascular reactivity, psychological distress, and coping responses in the South African context? Do biological gender and ethnicity significantly influence this relationship?*

2. Method

2.1. Research Design

A critical review design (De Klerk & Pretorius, 2019) was utilized in order to answer the research questions. This critical review study aimed to review scientific literature in order to conceptualize an understanding of the relationship of OSA with physiological (cardiovascular reactivity) and psychological aspects (psychological distress and coping responses), more specifically within the South African context. This design enabled the researchers to search for a variety of literature, as well as evaluate the search quality, recognize patterns, and make meaning of the patterns found (De Klerk & Pretorius, 2019; Garrod, 2023; Grant & Booth, 2009).

2.2. Search Approach

This critical review study was conducted between January and March 2023, and

the following databases were searched: EBSCOhost, Academic Search Complete, E-Journals,ERIC, SA ePublications Service, ScienceDirect, Google Scholar, Academic Search Premier, SocINDEX with Full Text, PsycARTICLES, PsycINFO, Web of Science, Cockhrane library, Library and Directory of Open Access Journals, as well as Theses and Dissertations in South Africa. The Boolean search terms, AND, NOT, and OR were utilized to provide more relevant search results. The following keywords were included in the search: "obstructive sleep apnea (OSA)", "cardiovascular reactivity", "psychological distress" and "coping responses/strategies". The search included studies that were peer-reviewed and full-text, published in the English language between 2012 and 2022. Initially, the search yielded 777 studies. Figure 1 below explains the search strategy approach that was followed, as well as the inclusion/exclusion criteria that were applied.

After the records from the initial search were identified and screened for relevance, the primary reviewer excluded all the studies as no studies were found indicating the relationship of OSA with physiological (cardiovascular reactivity)

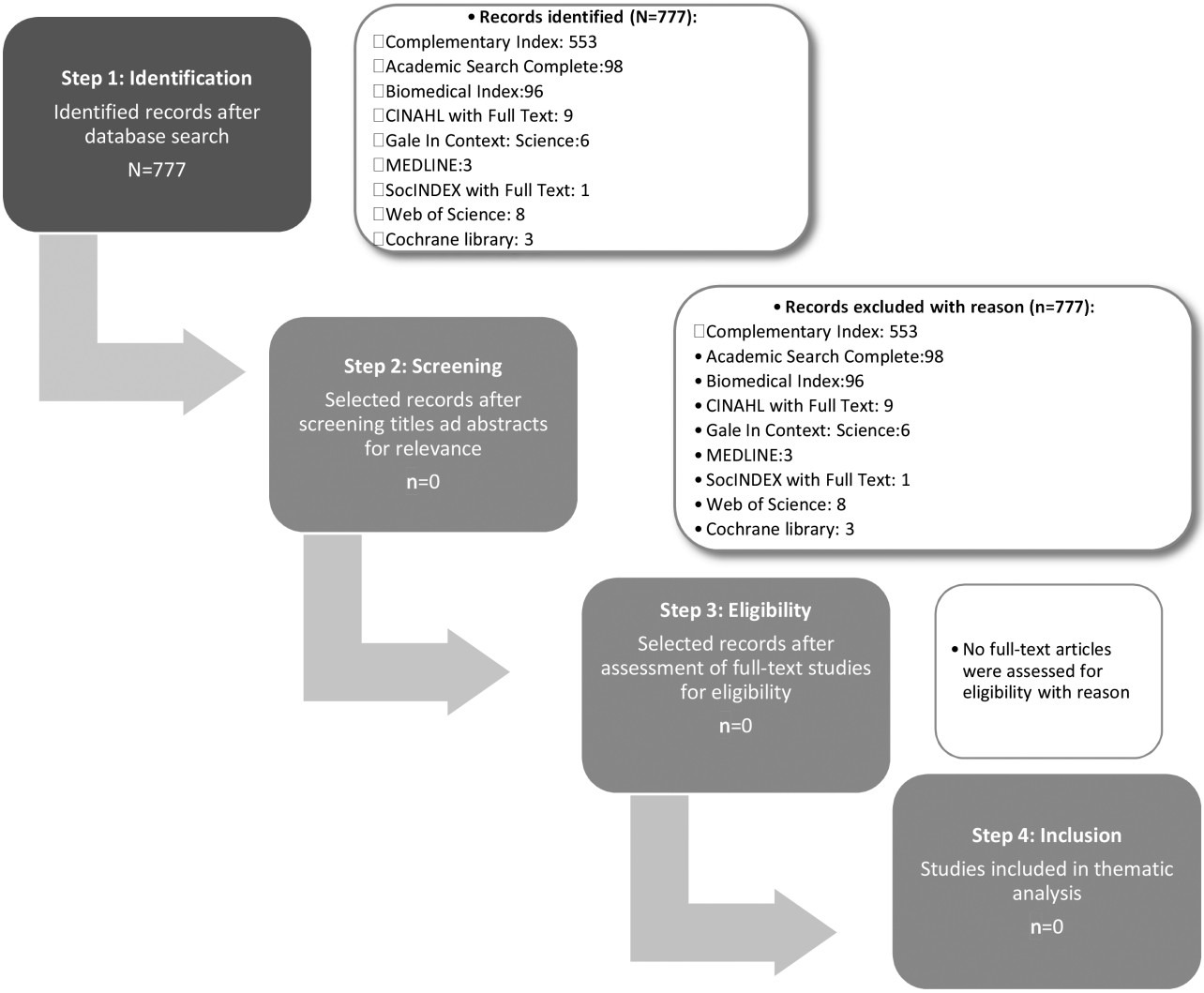

Figure 1. Search flow (no studies [n = 0] within the South African context found).

and psychological aspects (psychological distress and coping responses), more specifically within the South African context, but also in international sources. Therefore, the primary reviewer could not include any records for data analysis, as there are no studies to date providing a conceptualization of OSA in relationship with both physiological aspects (cardiovascular reactivity) and psychological aspects (psychological distress and coping responses), consequently, a summary of the themes separately related to the relationship of OSA with physiological (cardiovascular reactivity) and psychological aspects (psychological distress and coping responses) will be provided (see Findings and Discussion).

2.3. Procedure

This critical review research study received approval from the Health Research Ethics Committee (NWU-00173-22-A1) of the Faculty of Health Sciences, North-West University (NWU) in South Africa. An independent search was conducted by the primary reviewer (lead author), while a secondary reviewer (university librarian, Mrs. Gerda Beukman) also conducted an independent review process in order to confirm the findings of the first reviewer. The lead author applied the following seven steps as suggested by De Klerk & Pretorius (2019) in order to successfully conduct the critical review: 1) selecting and defining the review topic; 2) identifying sources of relevant scientific literature; 3) selecting and deselecting prominent literature; 4) data extraction; 5) analyzing and synthesizing extracted data; 6) presenting the review findings and discussion; 7) disseminating the conclusion and recommendations. However, after the scientific sources were identified and appraised for relevance, no sources answering the research question were found. Therefore, no data were extracted for further analysis and synthesis. This process was independently verified by the secondary reviewer to ensure that no sources were in fact available conducted on the relationship of OSA with both the physiological aspects (cardiovascular reactivity) and psychological aspects (psychological distress and coping responses).

Finally, the lead author assessed the quality of the research findings by implementing the SALSA (Search, Appraisal, Synthesis, and Analysis) framework (Grant & Booth, 2009), while adhering to guidelines for responsible and ethical knowledge production as suggested by Khumalo & De Klerk (2018).

3. Findings and Discussion

It is necessary to improve our understanding of the interaction between physiological aspects and psychological aspects by integrating psychological and physiological research related to sleep disorders (Roth et al., 2015). Due to the lack of available scientific sources (n = 0) giving an account of the relationship of OSA with both the physiological aspects (cardiovascular reactivity) and psychological aspects (psychological distress and coping responses), a summary and discussion on each of the aspects in this research study (cardiovascular reactivity, psychological distress, and coping responses) related to OSA will be provided separately

(see Table 1 for studies retrieved). The same Boolean search was conducted as discussed at section 2.2 of this article, however with the focus now being on each aspect separately (see sections 3.1, 3.2 and 3.3 of this article) in its relationship with OSA (including South African and international scientific literature).

3.1. Obstructive Sleep Apnea and Cardiovascular Reactivity

Lyons et al. (2020) suggest that there are several physiological reactions to consider in patients with OSA. This contribute to our understanding of the serious comorbidities and effects associated with OSA, since it is closely linked with several cardiovascular and metabolic diseases that could lead to cardiovascular morbidity and mortality (Blomster et al., 2015). OSA has been identified as an independent risk factor for various cardiovascular disorders and the prevalence thereof is growing by the day. Therefore, it is essential to diagnose OSA during the early stages as the appropriate intervention is required to prevent the development of OSA and the serious physiological consequences associated with it

Table 1. Key studies retrieved to support each aspect discussed.

Aspects	Research Studies Retrieved
3.1 Obstructive Sleep Apnea and Cardiovascular Reactivity (n = 31):	Alshak & M Das (2019); Blomster et al. (2015); Bonsignore et al. (2019); Bradley & Floras (2009); Carlson et al. (1996); Cinciripini (1986); Crinion et al. (2019); Drager et al. (2005); Efazati et al. (2020); Golbidi et al. (2012); Hall et al. (2018); Itzhaki et al. (2005); Kanagy (2009); La Rovere et al. (2008); Leger et al. (2012); Leung & Douglas Bradley (2001); Liu et al. (2016); Lyons et al. (2020); Moseley & Linde (2006); Narkiewicz et al. (1998a); Narkiewicz et al. (1998b); Narkiewicz & Somers (2003); Pal et al. (2021); Parati et al. (1997); Peppard et al. (2000); Somers et al. (2008); Uys (2012); Van Rooyen (2012); Wu et al. (2021); Zarei & Asl (2020); Ziegler et al. (1995).
3.2 Obstructive Sleep Apnea and Psychological Distress (n = 29):	Andrews & Oei (2004); Bixler et al. (2017); El-Ad & Lavie (2005); Gałecki et al. (2011); Garbarino & Magnavita (2014); Garbarino & Magnavita (2019); Guglielmi et al. (2018); Guilleminault et al. (1978); Harris et al. (2009); Hnin et al. (2018); Jackson et al. (2011a); Jackson et al. (2011b); Jackson et al. (2019); Jeon et al. (2021); LaGrotte et al. (2016); Lee et al. (2016); Lyons et al. (2020); McCall et al. (2006); Patel et al. (2004); Plante et al. (2017); Pochat et al. (1993); Sánchez et al. (2001); Sateia (2003); Saunamäki & Jehkonen (2007); Shoib et al. (2022); Stranges et al. (2012); Timkova et al. (2020); Vargas de Barros et al. (2013); Ye et al. (2008).
3.3 Obstructive Sleep Apnea and Coping Responses (n = 7):	Bardwell et al. (2001); Cowan & Livingston (2012); Gassara et al. (2017); Graven & Grant (2013); Scharloo et al. (2000); Tiemensma et al. (2016); Vaishali et al. (2021).

Note: The only South African research studies (n = 2) that could be retrieved were Uys (2012) and Van Rooyen (2012). Both these studies focused on OSA and cardiovascular reactivity.

(Blomster et al., 2015; Crinion et al., 2019). Previous studies have found a strong link between CVD and OSA, including hypertension, stroke, chronic heart failure, and arrhythmia (Bonsignore et al., 2019; Golbidi et al., 2012; Kanagy, 2009; Peppard et al., 2000). Yet, several patients with OSA do not present with obvious CVD but do however show changes in the structure and function of the cardiovascular system with marked atherosclerosis and endothelial defects, proposing that these systems contribute to the progression of cardiovascular morbidity (Drager et al., 2005; Golbidi et al., 2012; Itzhaki et al., 2005). OSA causes abrupt changes in autonomic, hemodynamic, chemical, inflammatory, and metabolic consequences, affecting cardiovascular changes, causing long-term physiological alterations that may worsen CVD (Bradley & Floras, 2009; Van Rooyen, 2012). This symptomatic sleep disturbance frequently results in significant drops in blood oxygen levels, resulting in life-threatening cardiovascular effects (Leger et al., 2012). Conversely, there are several fundamental physiological mechanisms, amongst other, sympathetic activation, that need to be considered in order to clarify the relationship between OSA and CVD (Golbidi et al., 2012; Somers et al., 2008). Sympathetic activation generates an increase in HR, a force of contraction, and rate of conduction in the heart, allowing for higher cardiac output to provide the body with oxygenated blood (Alshak & M Das, 2019) also referred to as cardiovascular reactivity.

According to Cinciripini (1986), cardiovascular reactivity is a physiological variable and is measured quantitatively, referring to how the cardiovascular system of the body responds to intervals of rest and exposure to external stressors by measuring the variation of HR and BP amongst others. The sympathetic nervous system is thought to be triggered in response to chemoreceptor stimulation generated by intermittent lack of oxygen and blood flow to the brain and hypoxia, as well as the frequent arousals associated with OSA (Blomster et al., 2015). The sympathetic nervous system (SNS), along with the parasympathetic nervous system (PNS), is one of the two divisions of the autonomic nervous system (ANS) from which functions and regions of the body are essentially regulated by these systems (Alshak & M Das, 2019). As explained by Alshak & M Das (2019), the SNS is responsible for the "fight or flight" reaction, whereas the PNS regulates the "rest and digest" response. Sympathetic activation refers to the preparation of the body for physical and psychological activity involving multiple organ systems, including the brain and heart to execute a specific demand posed by external factors (Alshak & M Das, 2019). Previous studies have used the changes in HR and systolic blood pressure (SBP) to establish cardiovascular reactivity in patients (Efazati et al., 2020; Moseley & Linde, 2006). Both the SNS and PNS are involved in OSA patients' HR, resulting in increased parasympathetic activity during apnea and thereafter increased sympathetic activity (Efazati et al., 2020).

Heart rate variability (HRV), can be defined as the fluctuation in the time interval between heartbeats and is one of the simplest non-invasive approaches for

cardiovascular monitoring (Efazati et al., 2020). HRV analysis is an effective approach for assessing autonomic system activity, which has a strong link to cardiovascular complications (Efazati et al., 2020). Wu et al. (2021) mention that alterations in HR patterns are linked to autonomic changes where sympathetic activation elevates HR, while parasympathetic activity reduces HR. Furthermore, Wu et al. (2021) state that irregular and disordered HR variations are linked to heart disease. Therefore, the analysis of HR fluctuations is essential in monitoring the development of heart disease and OSA as the latter cause autonomic alterations for a brief period of time (Wu et al., 2021). Furthermore, with apnea events, distinct sympathetic and parasympathetic tone levels can be determined by HRV, resulting in the evidence of how apnea affects other environmental systems, including cardiovascular and ANS (Zarei & Asl, 2020). Compared to healthy individuals, patients with OSA exhibit different waking blood pressure (BP) fluctuations and HR reactions to autonomic challenges (Pal et al., 2021). Heart rate variability (HRV), which measures variations in HR, is used to determine how OSA affects the ANS (Zarei & Asl, 2020). As a result, the regularity of short-term HR variations may be connected to OSA severity, with severe OSA patients having a lower regularity of short-term HR fluctuations (Wu et al., 2021), which can be better understood by examining the baroreflex sensitivity (BRS) respectively.

The examination of BRS is a widely utilized tool in the assessment of cardiovascular autonomic regulation (La Rovere et al., 2008; Van Rooyen, 2012). In many chronic disorders, and specifically with severe stages of OSA, impaired BRS have been known and considered as a measure of cardiac autonomic disturbance (Blomster et al., 2015). In addition, more erratic BP indicates altered baroreflex control, which is typical of people with OSA (Carlson et al., 1996; Narkiewicz et al., 1998b; Ziegler et al., 1995). Increased BP activates baroreceptors in the carotid sinus and aortic arch, which suppress sympathetic outflow, increase cardiac vagal outflow, and lower HR in a healthy person (Leung & Douglas Bradley, 2001; Van Rooyen, 2012). As a result, it is clear that decreased BRS might lead to increased sympathetic activation and decreased parasympathetic nerve activity (Blomster et al., 2015; Parati et al., 1997). The recurrent nocturnal spike in arterial pressure in OSA patients may down regulate baroreceptors and reduce BRS (Leung & Douglas Bradley, 2001). It has been discovered that OSA patients have a characteristic loss in BRS, which is evident during both alertness and during sleep (Van Rooyen, 2012). The underlying mechanism responsible for the lowered BRS is assumed to be sympathetic activation produced by nocturnal upper airway collapses, recurrent apnea resulting in hypoxia and awakenings (Narkiewicz et al., 1998b; Somers et al., 2008). Due to baroreflex dysfunction, the high level of sympathetic activity found in OSA is linked to changes in cardiovascular variability (Narkiewicz et al., 1998a; Parati et al., 1997), which are not limited to sleep and can last throughout the day (Narkiewicz & Somers, 2003). According to Blomster et al. (2015) in patients with OSA, sympathetic activation and depressed BRS have been postulated as a key component in the development

of CVD, morbidity, and death (Blomster et al., 2015).

Although previous research indicated several risk factors for sleep apnea such as increasing age, male gender, obesity, smoking and postmenopausal conditions in women globally, it remains of paramount importance to consider the influence of gender on the relationship of OSA and cardiovascular reactivity. Pal et al. (2021) conducted a study regarding gender specific analysis that revealed females with OSA had substantially higher blood pressure variability (BPV), indicating a possible gender specific vulnerability, while a study conducted by Liu et al. (2016) found that the male gender is a significant risk factor for OSA and severe cardiovascular disease. In addition, the role of ethnicity should also be considered. Lyons et al. (2020) state that differences in OSA risk are influenced by ethnicity. There is a higher risk for OSA among African Americans in comparison to Asian, Indian, Hispanic, and European descendants, in comparison to a South African study where the findings is that there is no noticeable difference between males of African and Caucasian descent in terms of their high risk of sleep apnea (Lyons et al., 2020; Van Rooyen, 2012). However, in comparison to Caucasian males, African men displayed a more adverse cardiovascular profile, with significantly higher values for nocturnal SBP, nocturnal diastolic blood pressure, and nocturnal heart rate (DBP) (Van Rooyen, 2012). Furthermore, it was found that through the evaluation of autonomic and cardiovascular responses it was revealed that African males may have a greater cardiovascular risk (Uys, 2012). Therefore, it is essential to consider ethnicity as a contributing factor in understanding the differences associated with OSA risk and its relationship with cardiovascular reactivity in order to inform interventions to prevent serious cardiovascular disease. According to Hall et al. (2018) each of these physiological pathways may, in turn, inform multidimensional, integrated models of the impact of our waking and sleeping lives on the aetiology and clinical course of CVD, however, not a lot is known about the recent relationship of OSA and the physiological aspects within the South African context with specific reference to gender and ethnicity.

3.2. Obstructive Sleep Apnea and Psychological Distress

According to Jackson et al. (2011a), sleep-related breathing difficulties have a multifaceted impact on cognition and daily performance, involving a variety of overlapping physiological and psychological systems. Therefore, it is paramount to consider the significant psychological factors associated with OSA (Gałecki et al., 2011).

Timkova et al. (2020) state that apart from the physical symptoms that patients with OSA experience, they also suffer from psychological distress and according to previous research, various psychiatric disorders are also prominent in this population (Guglielmi et al., 2018; Shoib et al., 2022). However, these psychiatric illnesses could be triggered by OSA's biological and/or psychosocial effects (Pochat et al., 1993). According to Bixler et al. (2017) and Guglielmi et al.

(2018), OSA sufferers experience depression and anxiety symptoms more frequently than individuals who do not suffer from OSA in the general population. In OSA patients, psychological symptoms like depression and anxiety are among the most significant comorbidities that have been identified (Harris et al., 2009; Saunamäki & Jehkonen. 2007). Moreover, depression has been identified as the most common mood disturbance linked to OSA (El-Ad & Lavie, 2005; McCall et al., 2006), however, not all studies have found a correlation between mood disorders and OSA (Sateia, 2003). A study conducted by Jackson et al. (2019), found that high rates of clinical depression and antidepressant usage are linked to OSA. In total, a 23% prevalence of clinical depression was found in this study, furthermore, the study found that 75% of the patients in the study who were taking antidepressants disclosed having bipolar illness or hypertension as coexisting medical conditions and a high incidence of anxiety symptoms was also observed (Jackson et al., 2019). In addition, a study conducted by Lee et al. (2016) found that 46.2% of OSA patients reported a depressed mood being the most evident determinant of QoL. Conversely, another study found that anxiety, rather than depression was the most prominent independent predictor of QoL (Ye et al., 2008). However, although anxiety symptoms in OSA patients are less prevalent than depression in most studies, they are not uncommon (Jackson et al., 2011a). According to Sánchez et al. (2001), there is still dispute about the incidence of anxiety in OSA patients and its relevance to the nocturnal symptoms of OSA, much as there is about depression. Rather than the direct impact of sleep factors, the link between OSA and anxiety may be mediated through a patient's QoL (Sánchez et al., 2001).

The findings of a study (Shoib et al., 2022) conducted in India indicated that people with sleep apnea have a substantially greater incidence of comorbid mental disease. For depression, this tendency was more pronounced than for anxiety. There was a total of 46.7% mental morbidity in the group under study. Patients with OSA had higher rates of all mental disease disorders, but anxiety and mood disorders stood out the most, with the two most common conditions being depression (25.8%) and anxiety (11.5%) (Shoib et al., 2022). In addition, a key finding of the research was that patients with some type of mental disease had substantially higher rates of severe and moderate OSA than patients without a mental illness where OSA was present in 25.8% of the research participants who had depression, suggesting that OSA is a very common co-morbidity with depression (Shoib et al., 2022). Clinicians and researchers in the field of sleep frequently describe a link between OSA and psychological problems, particularly symptoms of depression and anxiety, although the extent of this link and the processes responsible remain unknown (Guglielmi et al., 2018). It's unclear whether depression is a fundamental symptom of OSA or if it develops as a result of OSA-related symptoms (sleepiness, sleep issues, irritability, social disengagement) or other OSA-related comorbidities (e.g., obesity, hypertension, etc) (Andrews & Oei, 2004; El-Ad & Lavie, 2005).

In addition, Guilleminault et al. (1978) state that emotional, psychological and personality changes are typical in OSA patients, due to fragmented sleep patterns and increased tiredness. Patients who are sleepy throughout the day may feel unmotivated, tired, and dissatisfied with their everyday tasks and irritability, restlessness, weariness, moodiness, depression, anxiety, and, in more severe cases, psychosis, paranoia, and illogical conduct may occur (Guilleminault et al., 1978). Excessive daytime sleepiness (EDS) appears to be more associated with the degree of depression and anxiety than hypoxemia (El-Ad & Lavie, 2005). However, a link between EDS and depressive symptoms has been shown in several cross-sectional and longitudinal investigations (LaGrotte et al., 2016; Plante et al., 2017). Patel et al. (2004) stress that quality sleep is essential for overall health and mental well-being with psychological distress being linked to both suspected OSA and perceived low sleep quality (Guglielmi et al., 2018). There is increasing evidence that average sleep length is decreasing, and the prevalence of sleep disorders is rising in both the Western world and low-income nations, posing a significant cost in terms of illness and death (Guglielmi et al., 2018; Stranges et al., 2012). Equally chronic sleep disorders are proven to be a risk factor for the development of CVD as previously mentioned, as well as difficulties with memory and concentration (Guglielmi et al., 2018).

Insomnia, sleep deprivation and decreased sleep duration have also been linked to poor health, both subjectively and objectively, as well as feelings of unhappiness in life and mood disorders (Guglielmi et al., 2018; Harris et al., 2009). The results of a recent study provide novel information about the connection between insomnia, OSA, and depressive symptoms by showing that depressive symptoms increase when insomnia and OSA coexist (Jeon et al., 2021). Moreover, in a study conducted by Guglielmi et al. (2018), they found that even if the relationship is diminished by poor sleep quality and tiredness, suspected OSA is linked to psychological suffering. Furthermore, it was found that sleep quality showed to be the most important factor in predicting psychological distress among the factors studied, where truck drivers who reported poor sleep quality had poorer psychological well-being than those who slept well (Guglielmi et al., 2018). According to Guglielmi et al. (2018), the relationship between OSA and psychological distress has not received adequate attention in the working population in comparison to the clinical population. Research among the working population found that participants with poor sleep quality are at risk for psychological distress (Garbarino & Magnavita, 2019; Vargas de Barros et al., 2013). However, a prior study found that among the working population with presumed (undiagnosed and untreated) OSA, a higher General Health Questionnaire (GHQ)-12 score was found, indicative of psychological distress (Garbarino & Magnavita, 2014), as well as links with decreased QoL and depression (Lyons et al., 2020).

In addition, a psychosocial level study conducted by Liu et al. (2016) indicated that there were decreased rates of schooling and employment among those who

experienced breathing pauses while they slept, signifying a more severe type of OSA. The assessment of health related QoL revealed that the autonomous living skills and psychological well-being of patients who reported more severe OSA symptoms had been significantly impaired (Liu et al., 2016). Alternately, Liu et al. (2016) found that individuals who are disconnected from social activity may also experience poor sleep quality, possibly because of a low mood or poor physical health. Current sleep complaints may have a negative effect on social involvement (Liu et al., 2016) having an impact on psychological well-being. According to Hnin et al. (2018), the occurrence of OSA in African Americans is similar to that of European descent individuals, however, there are no recent studies within the South African context that report on the influence of ethnicity with the prevalence of OSA and the relationship with psychological distress. Therefore, it is essential to conduct future research studies in gaining knowledge about the role that ethnicity plays in the relationship of OSA with psychological distress, in order to inform intervention programmes in assisting with the psychological comorbidities that OSA patients suffer from.

Gender is another variable to consider. In the general community, according to McCall et al. (2006), females are more likely to report more severe depressive symptoms. Consequently, there is not sufficient and recent data showing this relationship within the South African context, specifically considering gender and ethnicity. According to Jackson et al. (2011a), depressive symptoms may make it more challenging to adhere to OSA treatments like continuous positive airway pressure (CPAP) or weight loss. These findings have clinical relevance for mental health providers who are evaluating individuals with depression who may also have a sleep disturbance. Sleep problems may worsen depression symptoms and reduce therapy effectiveness (Jackson et al., 2011b). Therefore, it is essential to consider the coping responses and mechanisms utilized by patients suffering from OSA.

3.3. Obstructive Sleep Apnea and Coping Responses

Effective coping skills may be beneficial in the treatment of chronic disorders, such as OSA (Gassara et al., 2017). Coping is described as a strategy for dealing with a situation that uses a combination of cognitive and behavioral techniques to overcome external or internal demands that are deemed either challenging or beyond a person's capabilities (Lazarus & Folkman, 1984). Furthermore, coping strategies can be defined as either a series of actions or a process of thinking utilized in addressing a stressful situation or adapting one's reaction to a specific situation (VandenBos, 2007). Coping strategies are classified as either active (or approach) or passive (or avoidance) approaches and are defined as being intentional, reasoned means of dealing with life's anxieties (Reber, 1985). Confrontational coping, seeking social support, planned problem solving, and positive reappraisal are all active approaches to coping with distress (Folkman & Lazarus, 1988). Isolation, self-control, accepting responsibility, and escape/avoidance are

examples of passive techniques (Folkman & Lazarus, 1988).

Coping skills are helpful in handling everyday anxiety, but they become much more critical when dealing with the added stress of living with a chronic disease such as OSA (Bardwell et al., 2001). As explained by Bardwell et al. (2001), the greater the extent of depressed symptoms described by OSA patients, the more passive and less active coping mechanisms they indicated. The study further demonstrated that the severity of depressed symptoms reported by OSA patients may not be attributed simply to the illness's consequences, as behavioral and psychological traits (e.g., coping strategy selection) may play a role in identifying whether OSA patients would experience more mood symptomatology. In several research studies, problem-focused coping was found to be the most effective in dealing with illness (Graven & Grant, 2013; Tiemensma et al., 2016), particularly in the mental health sector (Scharloo et al., 2000). Recent research has found that the more active and less passive coping mechanisms indicated by OSA patients, the less depressed symptoms they encounter (Gassara et al., 2017). In addition, Gassara et al. (2017) found that depression is common among OSA patients, and that coping style appears to have a major impact on their emotional well-being.

Coping strategy selection is an essential behavioral feature of personality that has been investigated in depression and chronic disease research (Bardwell et al., 2001) and therefore it is crucial to determine the relationship between OSA and the coping strategies employed in order to contribute to the utilization of treatment plans. One study conducted during the Covid-19 pandemic reviewed the coping strategies that patients suffering from OSA can utilize in dealing with stressful situations. Educating and engaging in exercise can assist patients in dealing with symptoms associated with OSA (Vaishali et al., 2021), as well as increasing social support through support groups and sharing their personal experiences (Cowan & Livingston, 2012). Finally, there is limited literature available on how gender and ethnicity influence the choice of coping strategies in patients suffering from OSA, specifically in the South African context. Therefore, future research is essential in understanding this relationship in order to develop effective intervention strategies.

4. Implications of the Findings for the South African Context

OSA is a common chronic disorder marked by recurring episodes of total (apnea) or partial (hypopnea) upper airway blockage, resulting in hypoxemia and hypercapnia, cortical micro arousals, increased oxidative stress, and sleep disruption (Peppard et al., 2013). According to Chang et al. (2020), there is a paucity of OSA prevalence research in the general population, particularly among young adults in African nations. OSA has been linked to a number of the most prevalent health problems, resulting in increased morbidity, death, and social and economic costs (Lyons et al., 2020). From the studies reviewed in this critical review study, both within the South African context and internationally, there were no studies included for analysis due to the lack of available literature

on accounting for the interplay between OSA, cardiovascular reactivity, psychological distress, and coping responses. To address this worldwide burden, we will need to make good use of breakthroughs in our knowledge and understanding of OSA, as well as the technologies available for detecting and managing OSA and its accompanying comorbidities, as well as improvements in global health infrastructure for the benefit of everyone (Lyons et al., 2020), especially for those within the South African context. In order to accomplish this within the South African context, it is essential that future research should investigate the relationship between OSA and physiological aspects; referring to BP, HR, and cardiovascular reactivity measures, as well as psychological aspects; referring to psychological distress and coping responses, with specific reference to gender and ethnicity in order to contribute to our understanding of this phenomenon within our local context.

5. Limitations of the Research Study

The findings of this critical review research study were very limited as there were no studies (n = 0) found in both the South African context and internationally, indicating a relationship between OSA with both the physiological aspects (cardiovascular reactivity) and psychological aspects (psychological distress and coping responses). However, there were studies accounting for the relationship between OSA and cardiovascular reactivity (n = 31), psychological distress (n = 29), and coping responses (n = 7), separately. For this reason, a summary was provided to give account for the findings of these studies in order to gain a deeper understanding of what conclusions can be drawn from recent research. Therefore, this critical review research study provides a basis for future research studies on the relationship of the interplay between OSA, physiological aspects (cardiovascular) and psychological aspects (psychological distress and coping responses within the South African context.

6. Recommendations

Early detection of persons at risk for sleep disorders, specifically OSA, by means of comprehensive screening is a feasible and cost-effective strategy that could contribute greatly to individuals' health and well-being (Guglielmi et al., 2018). It is recommended that further research into the linked comorbidities in OSA patients across age and ethnic groups might help identify those who would benefit from targeted screening and treatment (Lyons et al., 2020), both physiologically and psychologically. Therefore, based on the findings of this research study (a critical review of literature), it is recommended that future research should aim to understand how OSA relates to physiological and psychological aspects, specifically pertaining to cardiovascular functioning, psychological distress, and coping responses specifically in the South African population, especially investigating the role that ethnicity and gender plays between these aspects related to OSA. This will provide a better understanding of how at-risk populations can be

supported by means of intervention and support programs, as well as recommendations for treatment. Consequently, these findings could contribute to the development of psychological intervention programs in order to increase the psychological well-being of patients suffering from OSA. Finally, the identification of unique, multifactorial risk factors and mechanisms through which our waking and sleeping lives interact to bestow resilience or risk to cardiovascular morbidity and mortality could greatly improve public health if psychological and sleep research approaches are continued to be integrated (Hall et al., 2018).

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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